BOART LONGYEAR

LF70

Operations and Service Manual

MKT1576

BOART LONGYEAR

Important Safety Information

Hazard Signal Words

Hazard signal words are used throughout this manual. They appear in the narrow left-hand column of numerous pages and, with their additional text description, are intended to alert the reader to the existance and relative degree of a hazard.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury and death.

DANGER indicates an **imminently hazardous situation** which, if not avoided, **could result in death or serious injury.**

WARNING indicates a **potentially hazardous situation** which, if not avoided, **could result in death or serious injury.**

CAUTION indicates a **potentially hazardous situation** which, if not avoided, **could result in minor or moderate injury.**

CAUTION used without the safety alert symbol indicates a **potentially hazardous situation** which, if not avoided, **may result in property damage.**

BOART LONGYEAR

Important Safety Information

WARNING

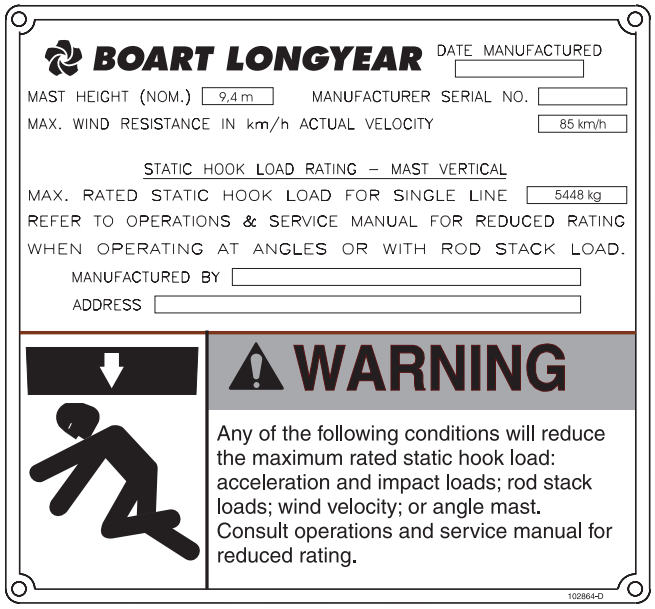
Read and understand all safety instructions carefully before operating this machine. Failing to follow these instructions may result in serious personal injury or death.

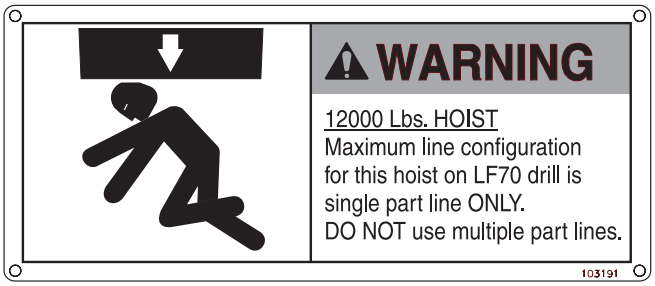
- Keep clear of rotating equipment. Never wear any loose clothing which could become tangled in the machine.
- Never rotate the drill rods without the water swivel attached to the drill string. (Ensure the hoisting cable is attached to water swivel bail.)
- Never rotate the drill rods with a rod joint located behind or above the chuck.
- Keep guards installed and maintained in good working order.
- Always keep the work area clean.
- Avoid dangerous working environments.
- Do not operate equipment while under the influence of drugs, alcohol, or medication.
- Keep visitors a safe distance away from the work area.
- Wear personal protective equipment such as a hard hat, safety glasses, ear protection and steel toed work boots.
- Read and understand the operations manual and labels affixed to the machine.
- Use only Boart Longyear replacement parts. Failure to do so could cause severe damage to the machine or result in operator injury, and may void your warranty.
- Use only qualified service technicians. Failure to do so could cause severe damage to the machine or result in operator injury, and may void your warranty.
- Never climb on top of the machine.
- Ensure that the drill and accessories fully comply with applicable local safety and health regulations.
- Do not exceed rated capacity of any piece of equipment.
- DO NOT store the overshot in the mast as this could result in damage or injury.
- Never rotate the drill rods with a rod joint located behind or above the chuck.
- Do not adjust the hydraulic system before consulting a Boart Longyear Technician.

- Ensure that all commissioning checks and adjustments have been thoroughly carried out before operating the machine.
- Ensure the drill is level and properly anchored before use.
- Do not change or alter the drill, its components, optional equipment or accessories without prior approval from Boart Longyear Inc. Unauthorized alteration may void the warranty, render the equipment unsafe or result in decreased performance.
- Before operating any controls, be certain you know what function they control and the ramifications of that function.
- Before operating any hoist, ensure the rope is free and clear to travel.
- When hoisting/lowering rods, make sure the hoisting cable is in complete tension before releasing the chuck.
- For additional information on training or start up, contact your Boart Longyear representative.
- Do not use multiple part lines on the main hoist of the drill.
- Ensure that all commissioning checks and adjustments have been thoroughly carried out before operating the machine.
- Always wear a full body ladder climbing harness with the shortest possible lanyard attached to a certified fall arrestor system while working on the platform.
- Be aware of the travelling hoist plug at all times.
- Be careful not to drop any tools when working on the platform.
- Never exceed the rod rack derating weights.

NOTE: See following page for safety decals that appear on the machine.

Important Safety Information





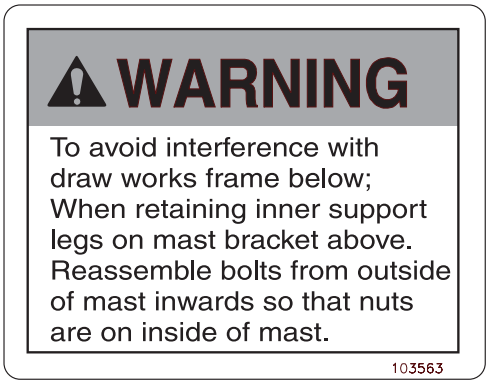


Table of Contents

NOTE:

Actual equipment may not be exactly as shown and should be verified with your Boart Longyear representative.

Not withstanding any other statements that may appear in this publication, Boart Longyear makes no guarantee that adoption of its suggested guidelines will yield a specific performance; neither does it accept responsibility for any lose, damage, or other consequences that may so arise.

All volumes are in US gallons and litres.

Release date: December 2005

Drill Introduction

General Information

The purpose of this manual is to furnish the operator with detailed information which will enable him to achieve the maximum operating performance from his drill. It will also give information necessary to perform preventative maintenance and make minor repairs and adjustments.

Boart Longyear is backed by over 100 years of experience in the design, manufacture and operation of core drilling equipment. Many of the accepted practices in use today were pioneered by Boart Longyear.

To obtain the utmost in performance and life of the equipment, it should be given regular care and operated in accordance with the instructions.

Read this manual carefully before attempting to operate the drill and keep this book handy at all times for reference when any question arises.

Ordering and Returning Parts

Ordering Parts

The following procedure will expedite the filling of your parts order, eliminate delays and assure correct replacement parts:

1. List the model and serial number of the drill.
2. State exact quantity required.
3. Specify description and part number as shown in Parts Manual.
4. Specify method of shipment, ie: Parcel Post, Express, Freight; for Overseas shipment, Air Freight, Air Parcel Post, or Ocean Freight.

All parts are priced F.O.B., our factory and a separate charge will be made for transportation and export packing.

Returning Parts

If you wish to return parts whether for repairs, replacement, or warranty, you should communicate the details of the return request in writing with your local Boart Longyear Representative.

In Canada the request can be sent
via email to: orderdeskrga@boartlongyear.com
faxed to: 705-474-2373

The request should reference the model and serial number of the product as well as:
-part number and quantity
-reason for return

Once the return is approved you will be issued an RGA (Return Goods Authorization) number to track your claim.

DO NOT attempt to ship parts until you receive an RGA number and shipping instructions otherwise we have no way to track your claim for returned goods. Boart Longyear will not be held responsible for any parts shipped without a return good authorization number.

- All parts for return are subject to incoming inspection and minimum re-stocking charge of 20% will apply
- Special, “made to order”, or obsolete, parts will not be accepted this includes small items such as nuts, bolts and o-rings.
- All parts must be returned prepaid

Standard Warranty

Boart Longyear Inc. makes no warranty that the products sold hereunder shall be merchantable or that such products shall be fit for any particular purpose and there are no warranties expressed or implied made by Boart Longyear Inc. except its following standard warranty.

Boart Longyear Inc. warrants each product, and accessory equipment sold by it (except items not manufactured by Boart Longyear Inc. such as power units, pumps, and other trade accessories sold with, attached to, or operated with Boart Longyear drills or other products) to be free from defects in material and workmanship under normal use and service for 90 days from date of use, but not to exceed 6 months from the date of shipment from a Boart Longyear Inc. factory, the obligation of this warranty being limited to the replacement or repair at a Boart Longyear Inc. facility in Ontario, Canada, or at a point designated by it, of such parts as shall appear to it upon inspection at such point to have been defective in material or workmanship at the time sold, providing that the part or parts claimed defective are returned to inspection point, transportation charges prepaid.

This warranty applies only to new and unused products and accessory equipment which after shipment from the Boart Longyear factory, have not been altered, changed or repaired in any manner.

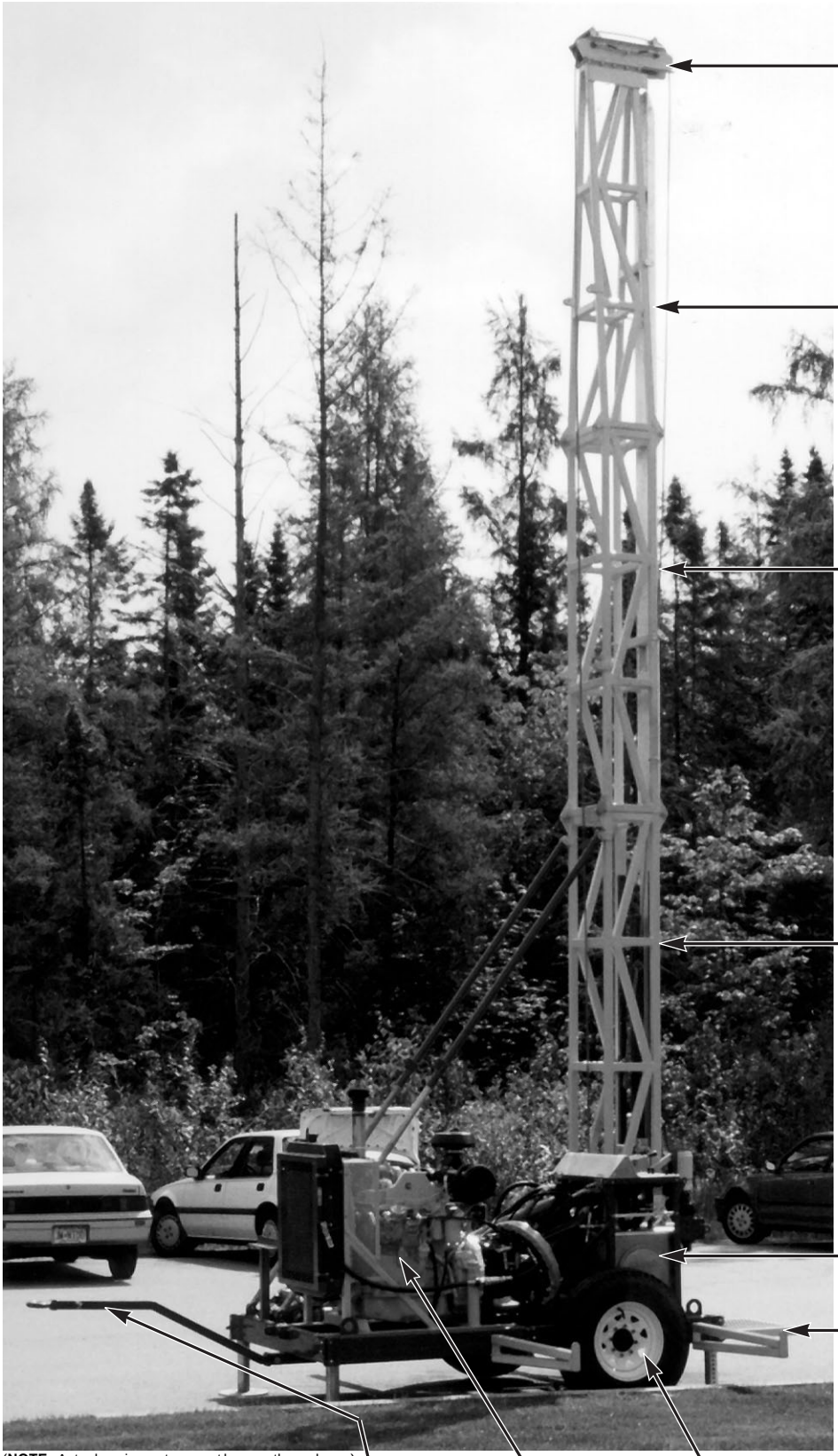
Exclusion of Liability for Consequential Damages

It is further agreed by the purchaser that in no event shall Boart Longyear be liable for increased costs, loss of profits or goodwill or any special, indirect, incidental, or consequential damages whatsoever.

Drill Introduction

General Drill Arrangement

(**NOTE:** Actual equipment may not be exactly as shown)



(**NOTE:** Actual equipment may not be exactly as shown)

Tech Data

See Appendix A

Drill Components

Drill Base

Included in the base are provisions for two single axle wheels, a towing hitch (pintle eye), four leveling jack legs (manual), four mud tank supports, operator's stand, battery box and fuel tank.

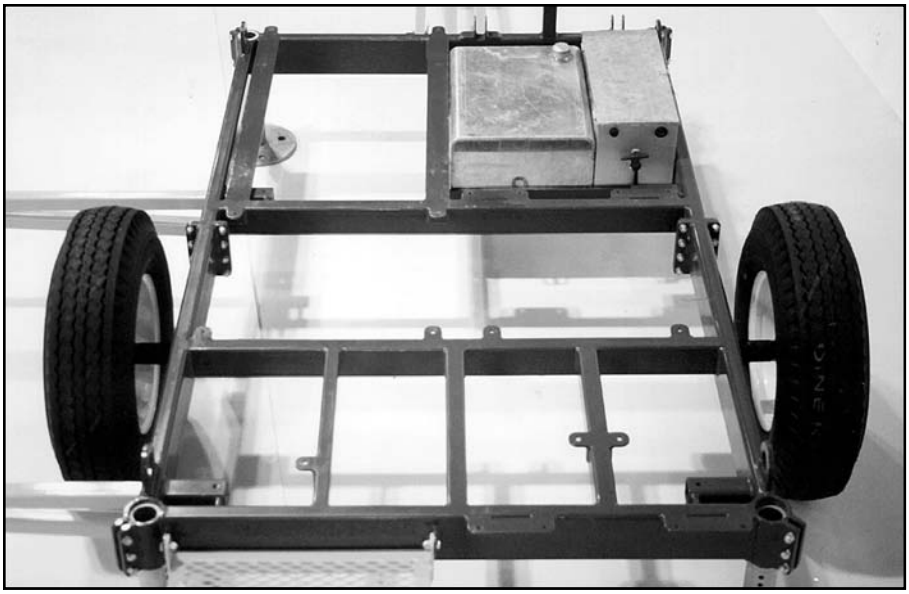
The base is such that all top side components can be easily positioned and slid into place during assembly of the drill.

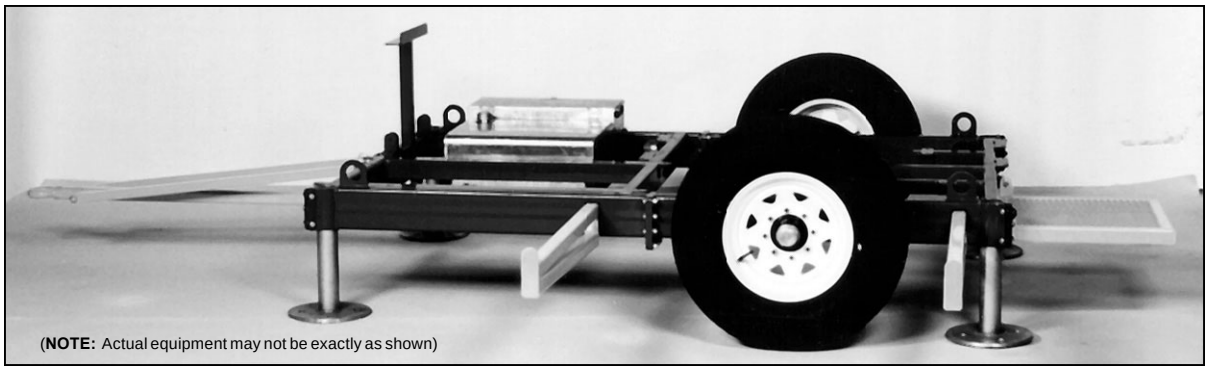
NOTE: The towing group is optional and includes two axles, wheels, and a towing hitch.

WARNING **The towing group is designed for off-road use only. Ensure that the towing vehicle used has the proper towing hitch rating**

Weight Base Complete -Including fuel tank (full), battery box and battery, 4 leveling jack legs, operator's stand, 4 mud tank supports, 2 wheels, towing hitch.

1398 lbs 635 kgs





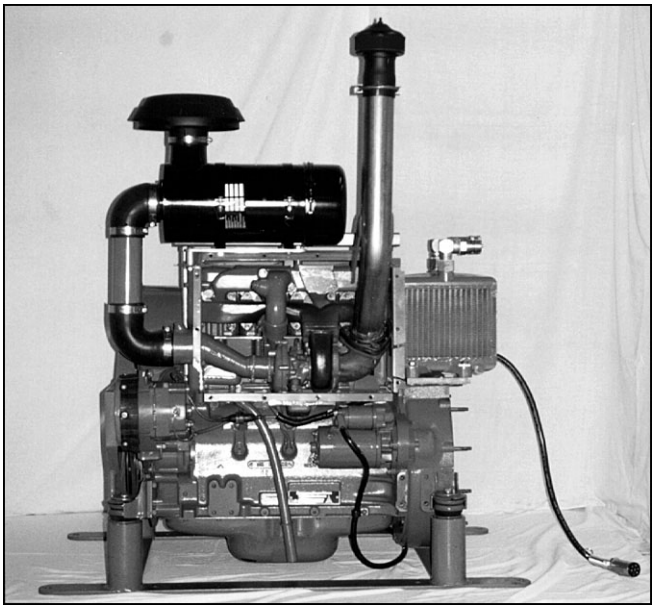
(**NOTE:** Actual equipment may not be exactly as shown)

Individual Components	**lb**	**kg**
Wheels and Stub Axle (each)	112	51
Battery Box & Battery	134	60
Fuel Tank (full)	125	57
Towing Hitch	55	25
Mud Tank Supports (each)	26	12
Leveling Jack Legs (each)	25	11
Operator Stand	26	12
Bare Base	630	286
Total Weight	**1398**	**634**

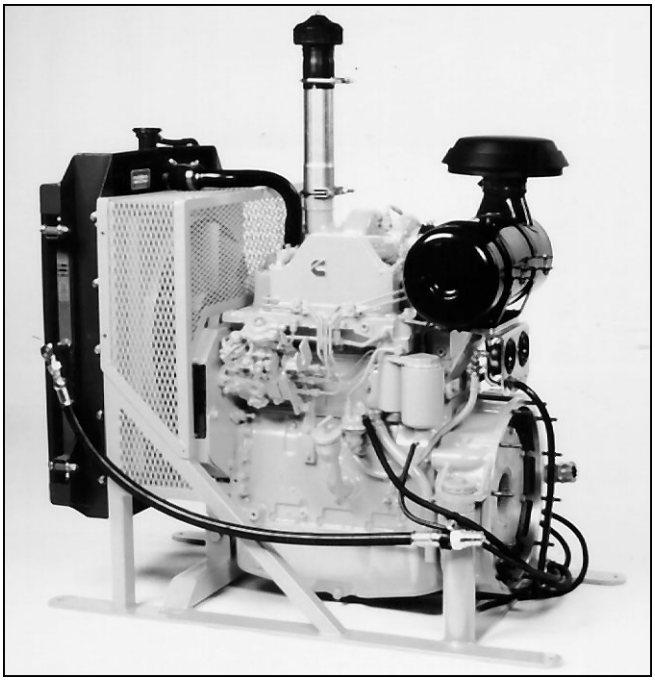
Recommended Tires - 7.50 x 16
Rims - 16 x 6.8 on 6-1/2 Hole Pattern
Stub Axle Pattern - 8 bolt G.M. 6-1/2 hole pattern

Power Unit Module

The standard power unit is a Deutz BF4L914 which is a turbocharged, air cooled, diesel engine rated at 97.5 hp (72 kW) with a displacement of 263 in^3 (4.31 litres).



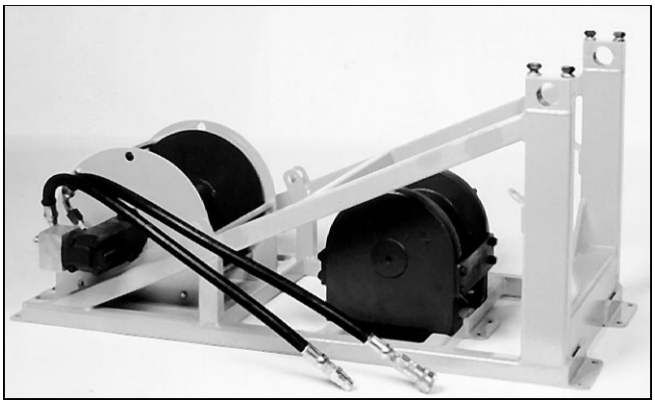
The optional power unit is a liquid cooled, 4 cylinder, turbocharged, after cooled, Cummins diesel rated at 131 hp (98 kw) with a displacement of 239 in^3 (3.92 litres).



The flywheel incorporates a composite toothed adapter plate which drives the hydraulic pumps. Murphy shutdown gauges for oil pressure and engine temperature are standard. Quick connect couplings for the air blast hydraulic oil cooler, battery, fuel lines, engine throttle, and electrical harness, allow the power unit to be quickly and easily removed from the drill. A spark arrester is included as standard on the exhaust.

Draw Works - Sub Frame Module

Contained on this sub assembly are the wireline hoist, main line hoist, and mast swivel mounting blocks. The wireline hoist is powered by a fixed displacement Geroler motor which incorporates a counter balance valve to prevent hoist overrun. The main line hoist is also powered by a fixed displacement axial piston with a counter balance valve to prevent hoist overrun. In addition, the main line hoist features a spring applied, hydraulically released brake and an internal Sprag bearing mechanism which ensures the main line hoist drum must be hydraulically powered to unlock the drum. (ie. The load cannot drive the drum ahead of the hydraulic motor.)

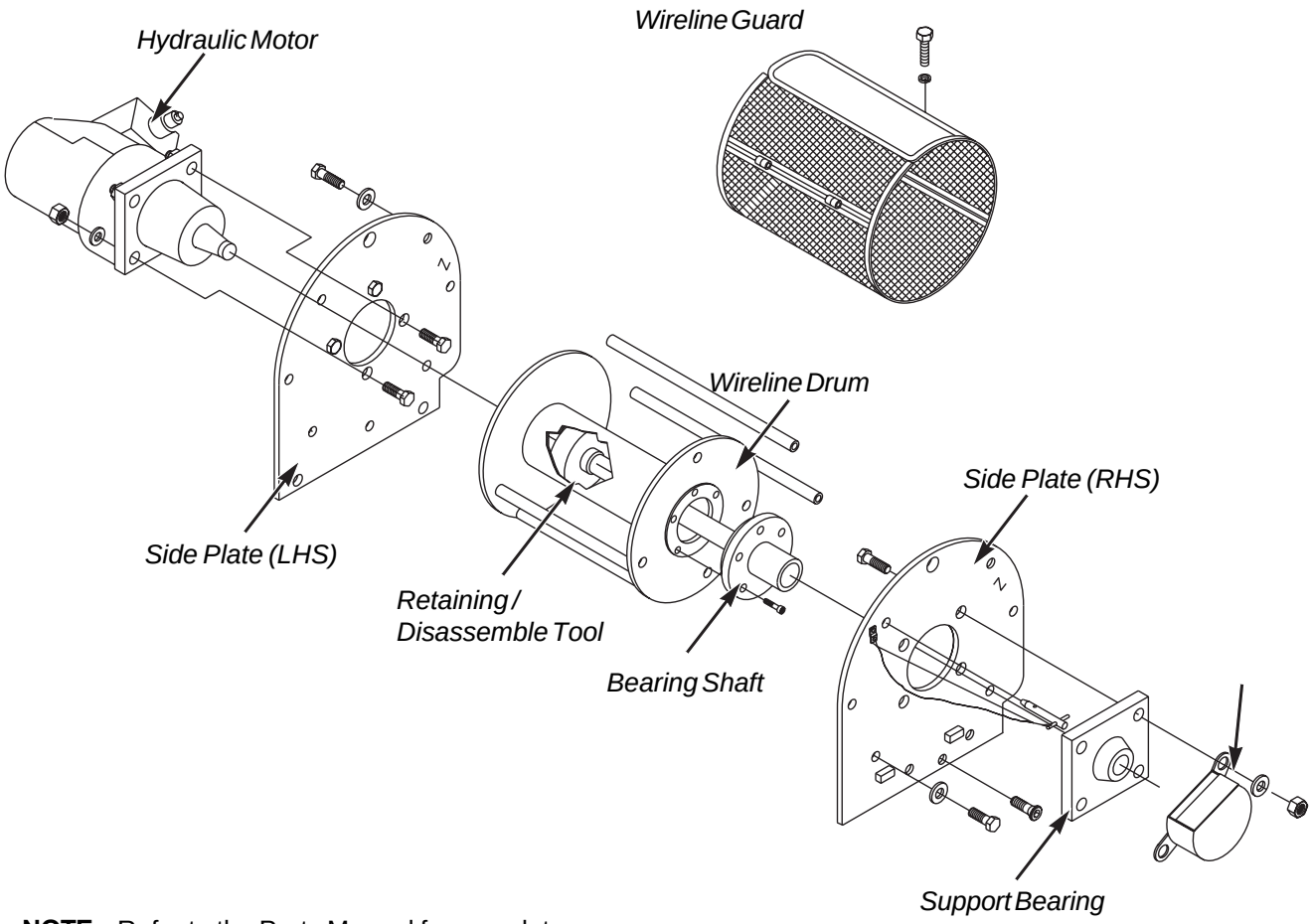


(**NOTE:** Actual equipment may not be exactly as shown)

Weight Draw Work Module c/w KPL12 main line hoist with 220 ft (67 m) of 5/8" (16 mm) hoisting cable and wireline hoist with 3200 ft (975 m) of 3/16" (4,8 mm) wireline cable.

993 lbs 450 kgs

Wireline Hoist Assembly



NOTE: Refer to the Parts Manual for complete

Lower Mast Section

The lower mast section pivots in the draw works sub frame to allow the desired drilling angles to be achieved. It also houses the feed cylinder which has the rod end directly connected to the base of the mast. The feed cylinder body is directly attached to the drill head carriage which slides on the upper face of the lower mast section.

The two mast support legs are retained on the lower mast section.

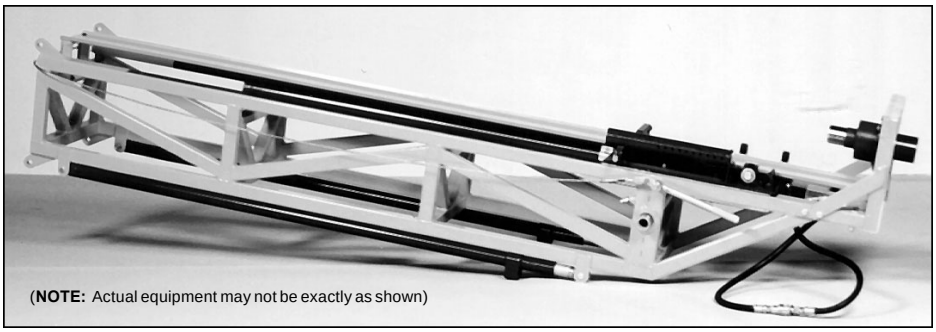
Also, located on this mast section is the operator's rod guide actuating lever for positioning the cable operated yoked rod centralizer plates which are located on both the middle and upper mast sections.

The bottom casing positioner base is removable and features a hollow spigot which retains the casing adapter collar and/or casing guide bushing.

Weight

Complete (including feed cylinder, rotation unit carriage and mast support legs).

900 lbs 408 kgs



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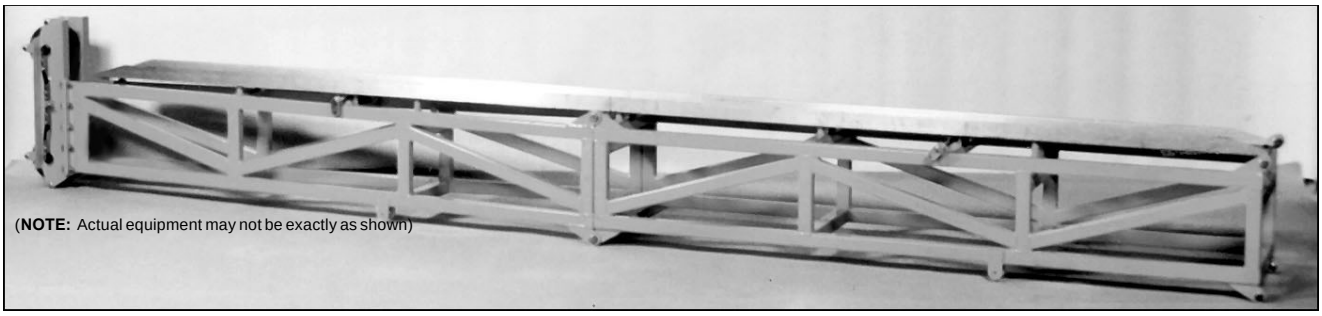
Upper Mast Section


(**NOTE:** Actual equipment may not be exactly as shown)

When the operator chooses to work with 10 ft (3 m) rod joints, the upper mast section is directly connected to the lower mast section. 10 ft (3 m) rod pulls above the drill head can be accomplished using this combination. As with the middle mast section, the upper mast section also has an aluminium rod slide and a yoked rod guide.

The upper mast section carries the crown block assembly which contains twin sheave wheels for the main line and wireline hoisting cables. The sheave wheel bushings are plumbed to a remote lubricating fitting positioned on the lower mast section near the control panel.

Middle Mast Section

When used with the upper and lower mast sections, the middle section facilitates rod pulls of 20 ft (6 m) above the head. An aluminium rod slide located on the front face of the mast, guides the hoisting plug when tripping the drill string. A yoked rod guide, which is actuated by a steel cable and lever arm from the operator's platform, centres the rod thread when making or breaking the string.

Middle and upper mast section combined weight

692 lbs 313 kgs

Hydraulic Module

This module contains the hydraulic pumps, valves, reservoir, hydraulic hoses, function controls, filters and gauges. The reservoir is constructed from aluminium to prevent internal corrosion and features 100 mesh suction strainers on each pump inlet. These are fitted with 3 psi (20 kPa) vacuum bypass valves which will allow full oil flow access to the pumps in case the strainers become blocked or when starting up in sub zero temperatures (32°F - 0°C).

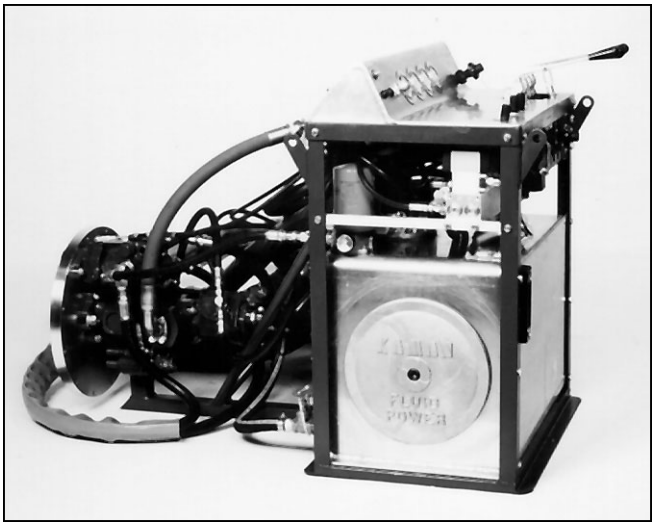
Weight

Complete with hoses, wet (including hydraulic oil).

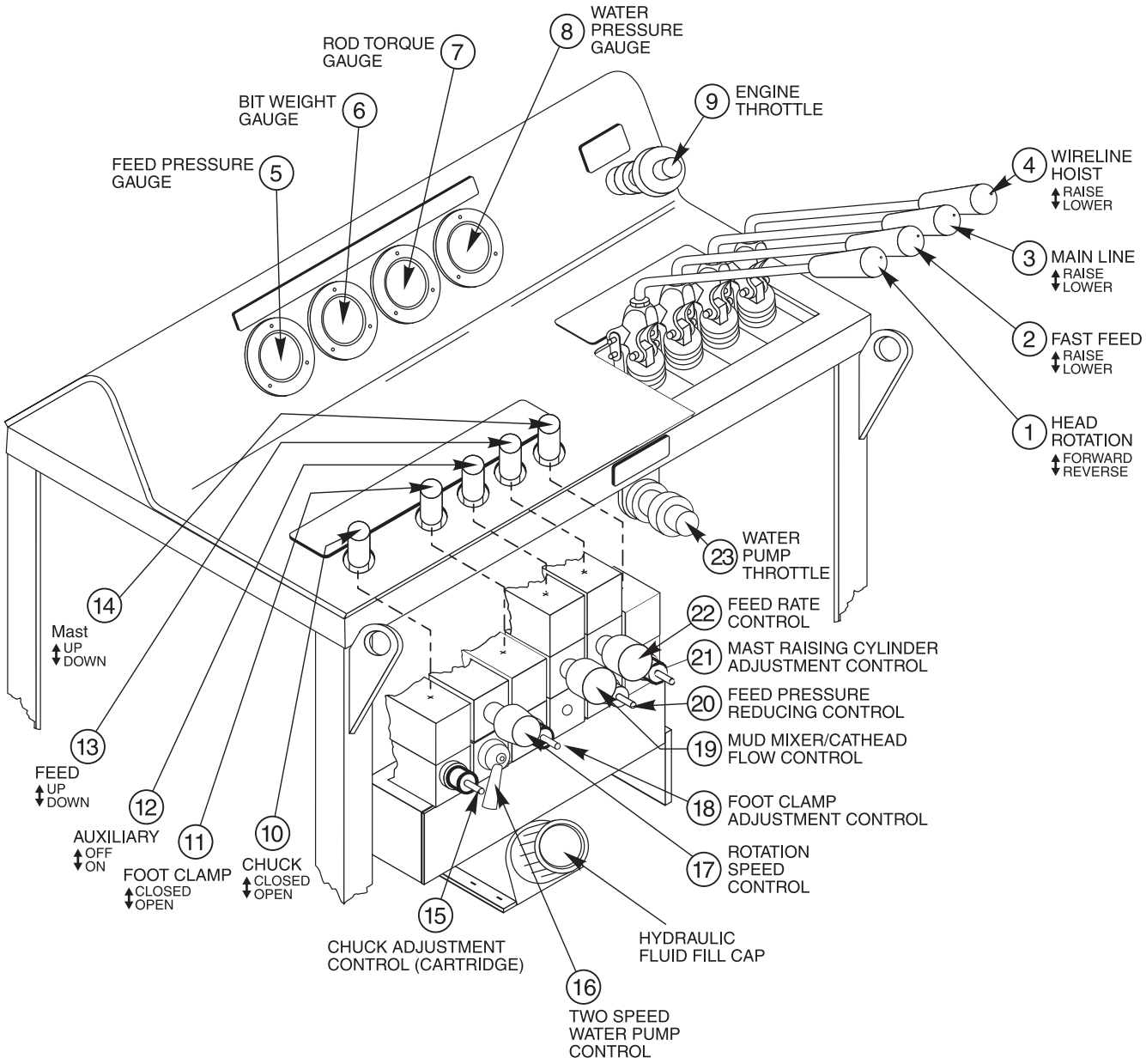
920 lbs 417 kgs

Oil Volume (operating level)

30 U.S. Gallon 114 Litres



Control Panel



(**NOTE:** Actual equipment may not be exactly as shown)

Drilling Operations

Introduction

The following are recommended guidelines and practices to help prolong the life of your newly obtained Boart Longyear mast.

Enclosed is a checklist for a visual inspection which should be done every 1000 hrs of operation. (Inspections may have to be done more often when operating in extreme environmental conditions.) Make copies of the checklist for each inspection. The checklist should be signed and filed for future reference.

Safeguards:

Operator shall be familiar with the equipment and its proper care. If adjustments or repairs are necessary, or if any damage is known, the operator shall report the details promptly to an appointed person and shall notify the next operator upon changing shifts.

In the mast erecting and lowering operations, ensure that the drill is securely anchored first. A slow practical operating speed should be used during this function at all times.

There is no way of judging the remaining strength of a rusty cable, therefore, rusty cable lines must be replaced immediately. Areas adjacent to end connections should be examined closely for any evidence of corrosion.

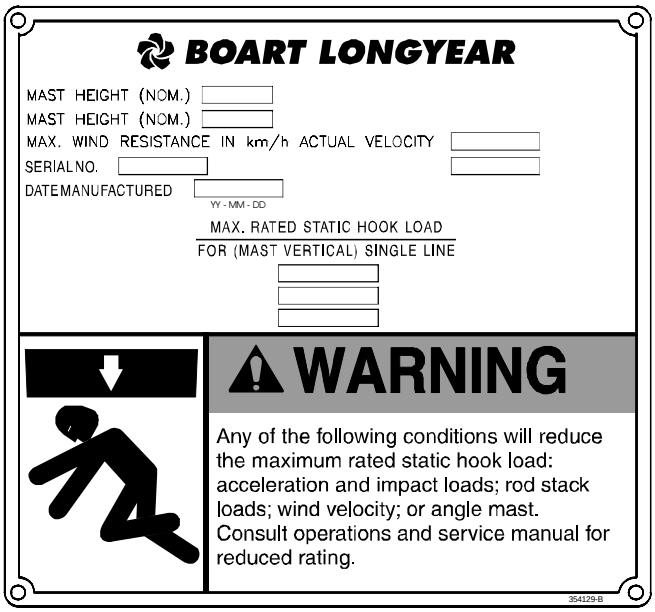
Design modifications or welding to the mast weldments is prohibited. These modifications could result in weakening of the mast members and therefore, possibly causing a structural failure later.

Routine checks should include:

- Inspection of welds in erecting mechanism for cracks and other signs of deformity.
- Inspection of wire rope, including operating lines, raising lines, and guy lines, for kinks, broken wires, or other damage. Make certain that guy lines are not fouled.
- Check unit for level and correct placement before erecting operation.
- Check lubrication of crown sheaves.
- During drilling operations, it is advisable to make scheduled inspections of all bolted connections to ensure that they are tight. 48 hours after the initial erection of the mast, check the bolts for correct torque.
- Ensure that the Load Rating and Warning decals are installed on the mast and are in good shape.
- Steel becomes brittle when operating in low temperature conditions. **EXTREME CAUTION** must be exercised when operating at or below -25°C (-13°F) as the mast may no longer hold the rated load. Frequent visual inspection of mast members and welds is even more critical at these temperatures, see page 8.
- Ensure support legs are located on a solid footing and tied back to a solid anchoring point.

⚠ WARNING

Never exceed the Rated Hook Load, which is indicated on the Load Rating decal. When calculating hook load, always include load handling devices (travelling blocks, etc.)



Visual Inspection of Masts

The following is a checklist for a visual inspection of the mast. Ensure that the inspection is performed by an individual with knowledge of all mast operational procedures during erection or relocation of mast. Each section has a pass or fail choice. If there is a problem, it should be noted and corrected immediately. Make copies of this checklist and file this check list for future reference.

1. Crown Assembly:

Condition:						
Sheaves	Warped	☐			OK	☐
Grooves	Worn	☐			OK	☐
Spacers or Seals	Bad	☐			OK	☐
Grease Fitting	Missing	☐			OK	☐
Crown Frame	Bent Flanges	☐	Bent Webs	☐	OK	☐
	Cracked Welds	☐			OK	☐
Comments:	Rusty	☐	Needs Repair	☐		
	Needs Painting	☐	Other: _____			

2. Vertical Members:

   A. Rear Leg, Off Driller's Side

Condition:						
Bow	Slight	☐	Bad	☐	OK	☐
Pin Connection	Bad	☐			OK	☐
Pin Hole	Bad	☐	Cracked Welds	☐	OK	☐
Safety Pins	Missing	☐			OK	☐

   B. Rear Leg, Driller's Side

Condition:						
Bow	Slight	☐	Bad	☐	OK	☐
Pin Connection	Bad	☐			OK	☐
Pin Hole	Bad	☐	Cracked Welds	☐	OK	☐
Safety Pins	Missing	☐			OK	☐
Comments:	Needs Repair	☐	Other: _____			

3. Bracing

Condition:	Slight Damage	☐	Badly Damaged	☐	Needs Repair ☐	OK ☐

4. Adjustable Support Legs and Feet

Condition:	Damaged	☐	Cracked Welds	☐	Corroded	☐
	Worn Pins/Hole	☐	Needs Repair	☐		

5. Working Platform

Condition:						
Racking Platform						
Frame:	Damaged	☐	Cracked Welds	☐	OK	☐
Pin Connections	Worn	☐			OK	☐
Safety Pins	Missing	☐	Worn	☐	OK	☐
Fingers	Damaged	☐	Needs Repair	☐	OK	☐
Working Platform	Damaged	☐	Cracked Welds	☐	OK	☐
Handrails	Damaged	☐	Needs Repair	☐	OK	☐

6. Guyline Anchorage

Condition:

Guyline	Damaged	☐	Needs Adjusting	☐	Needs Replacing	☐	OK ☐
Cable Clamps			Loose	☐	Needs Repairing		OK ☐
Turnbuckles			Damaged	☐	Needs Replacing		OK ☐
Anchor and Deadman			Replace	☐			OK ☐

7. Bolt Connections

All bolted connections are to be inspected, tightened, and missing parts replaced or visibly marked as missing or damaged and in need of repair.

All connections found to be satisfactory as checked and loose bolts tightened. OK ☐

All connections visually inspected and spot checked for tightness and no further bolt tightening or repairs necessary. OK ☐

8. Substructures for Mast

Damages:	Minor	☐	Major	☐	OK ☐
Corrosion:	Minor	☐	Major	☐	OK ☐
Condition:					
Connections	Worn	☐	Cracked Welds	☐	OK ☐
Safety Pins	Missing	☐			OK ☐

9. Mast Raising and Angling Cylinders:

Condition: Oil Leaks ☐ Hose/Tubing Damage ☐

10. Summary of Inspection

Appearance:	Good	☐	Fair	☐	Poor ☐
Repairs Needed:	None	☐	Minor	☐	Major ☐

Number of Missing Parts: _____

11. List of work to be completed:

_____

_____

_____

_____

_____

_____

_____

_____

_____

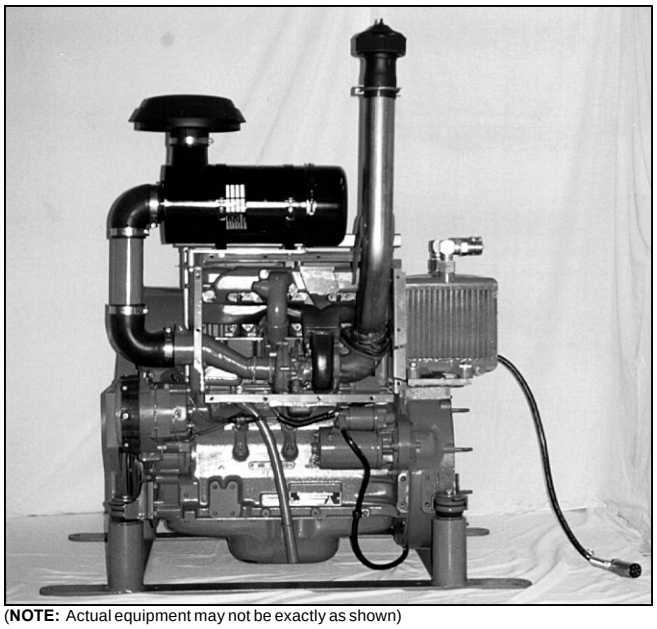
_____

Signature : _____ Date: _____

Ref No.: _____

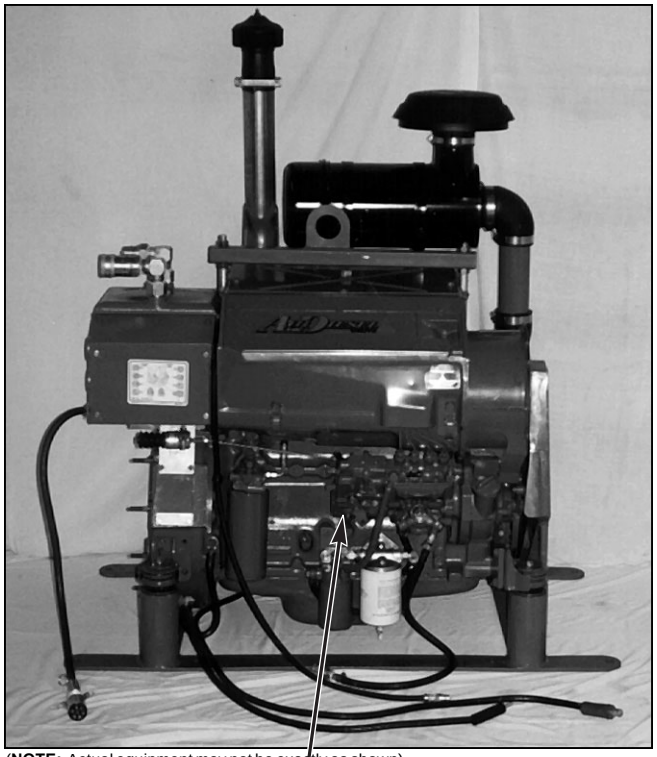
Pre Start Check List

1. Check diesel engine oil level.
2. Check all fluid levels. Refer to Lubrication Chart (page 9-05) for lubricant types and quantities.



(**NOTE:** Actual equipment may not be exactly as shown)

Deutz



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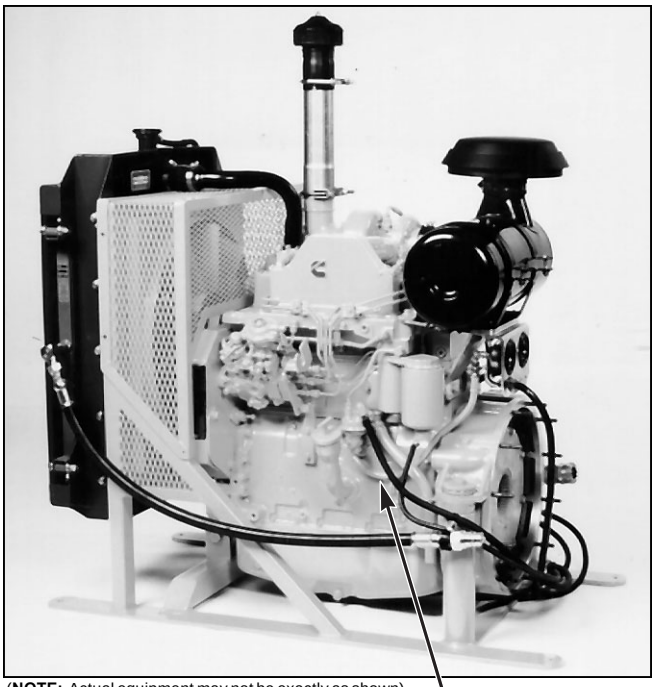

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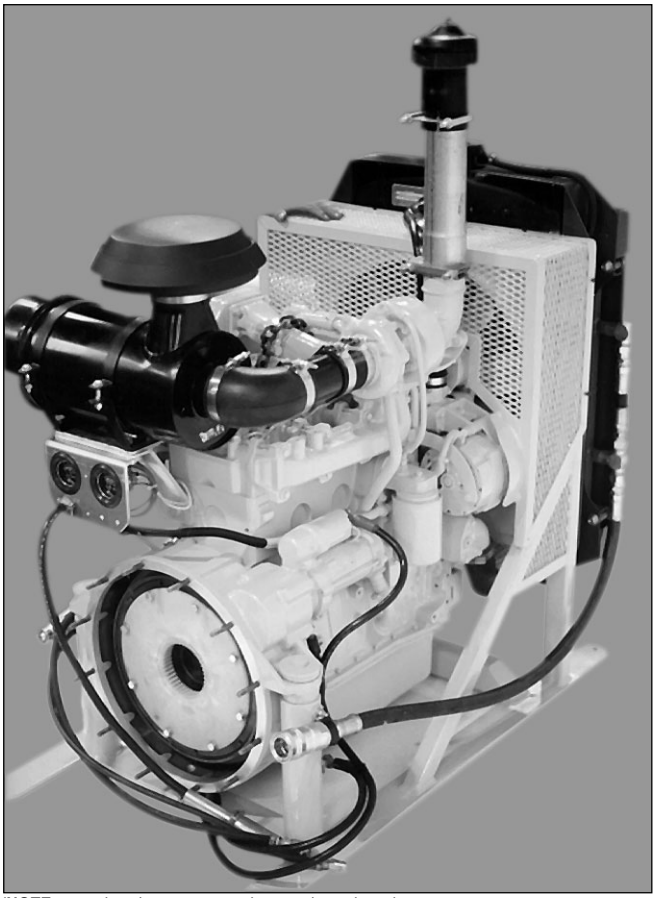
Cummins



(**NOTE:** Actual equipment may not be exactly as shown)

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CAUTION **If the mast has not been raised, ensure the drill is properly supported by the four leveling jacks in a level orientation. Before raising the mast, ensure there are no overhead power lines, trees or structures which could foul the tower during raising, drilling or lowering. Make certain there are no loose objects on the mast which may fall off during the raising of the tower or when operating the drill.**

If any of the above require attention, be sure to thoroughly clean the area surrounding the filler locations before adding liquids. Use only clean, uncontaminated containers for filling, not ones that have been used to hold foreign fluids.

For more detailed diesel engine servicing requirements, refer to the diesel engine operations and maintenance section of this manual.

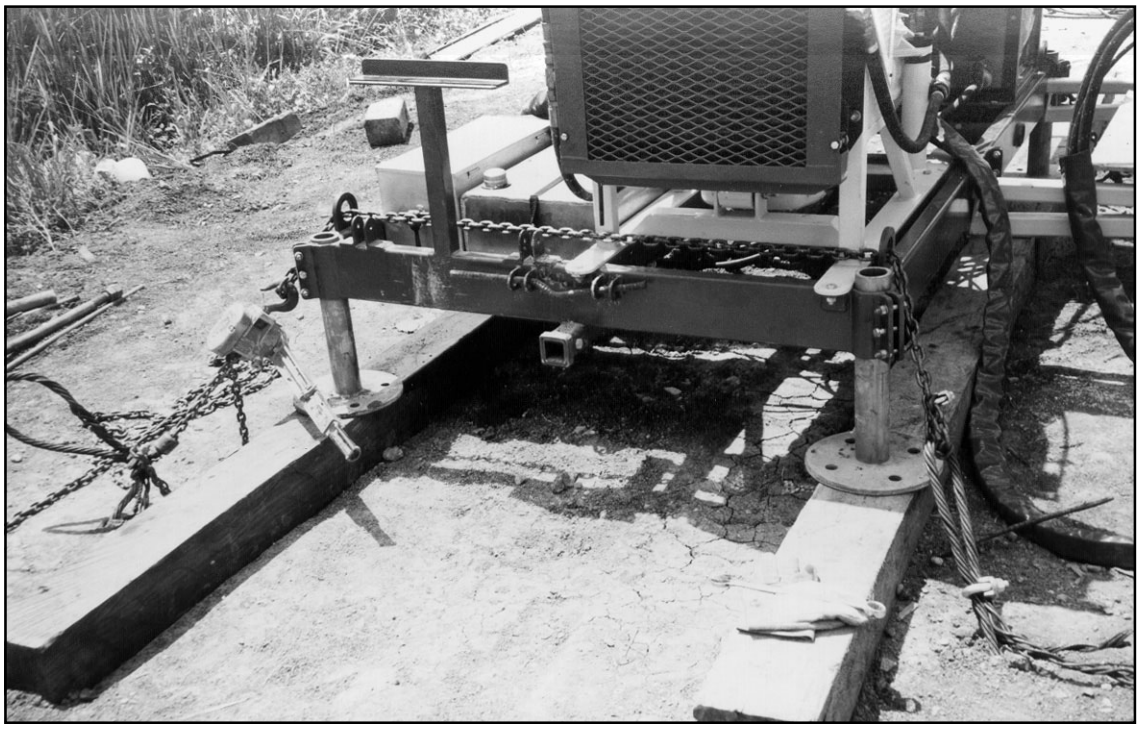
For more detailed hydraulic servicing requirements, refer to the recommended service intervals of this manual.

3. Visually check the drill for any loose or unserviceable components, leaks, faulty equipment, etc., and repair these before operating the machine.

Anchoring the Drill

CAUTION **Do not operate the LF 70 without the drill being levelled and securely anchored.**

The LF 70 is a highly mobile, lightweight diamond core drill. Because of these attributes, it is essential that the drill is securely anchored to the formation being drilled. This can be achieved in a variety of ways which will be discussed below.

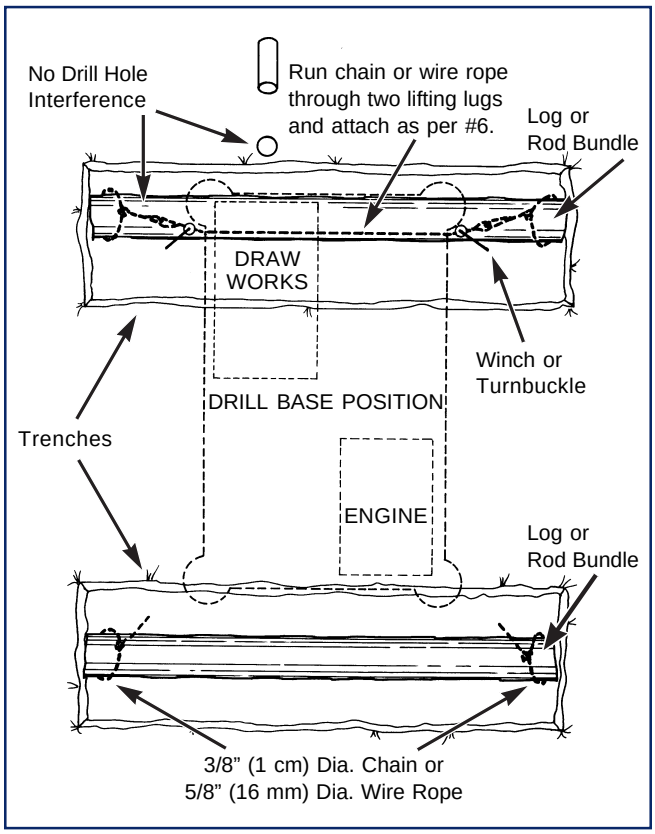


CAUTION **Ensure that log or rod bundle (3 rods) placement at the rear of the drill will not interfere with any proposed drill hole angles.**

Unconsolidated Overburden

The most expeditious means of securing the LF 70 in unconsolidated formations is to use twin anchor logs cemented and buried in the ground with chain or wire rope attached to them, protruding to the surface. The chain or wire rope can then be passed through the lifting eyes on the four corners of the drill base and the entire machine “cinches” down onto supporting timbers.

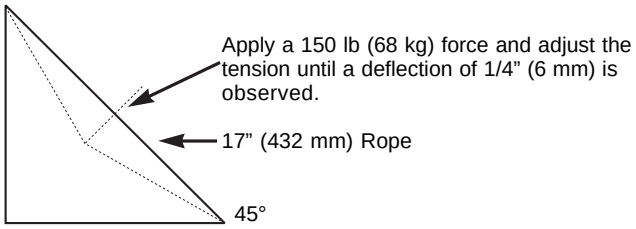
1. Dig two trenches 10 ft (3 m) long and 3 ft (1 m) wide in front of and behind the drill. These trenches should be a minimum of 3 ft (1 m) deep.
2. Place a minimum of a 10” (25 cm) diameter log (hardwood in good condition) or alternately, 3 old 10 ft (3 m) HQ drill rods in each trench. Securely fasten enough 3/8” (1 cm) diameter chain or 5/8” (16 mm) wire rope to each end of the log or drill rod bundle so there will be 5 ft (1.5 m) protruding from the surface after the trenches have been filled.
4. Place a covering of rocks and boulders over the logs or drill rod bundles and lay the free end of the chain or cable over the top of the trench, removing any slack.
5. Cement the log or rod bundles into position with enough grout mixture to cover the layer of rocks and boulders. Backfill and compact the soil into the trenches and restore the site to a level position. Allow 12 hours for the cement to cure.

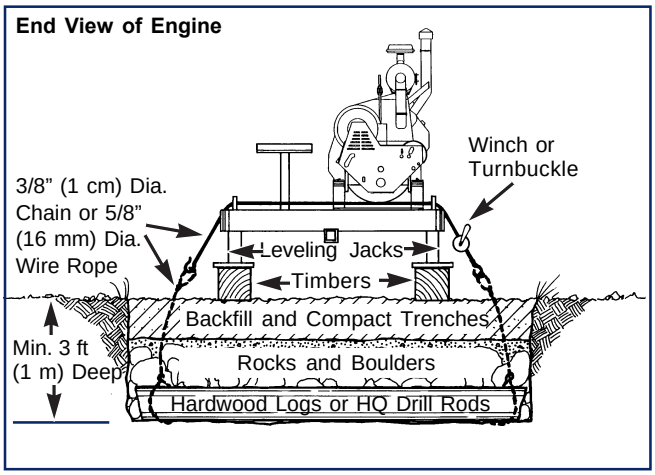


6. Position some 10" X 10" (25 cm X 25 cm) timbers longitudinally under where the drill base levelling jacks will be positioned.

7. Place the drill on the timbers and run additional 3/8” (1 cm) chain through the two front and two rear lifting lugs on the drill base. Attach each chain to one free end of the chain or wire rope protruding from the trenches (which is attached to the cemented log or rod bundle) and tension the drill down with a come-along style winch, turnbuckles, etc.

   Chain or wire rope must be adequately pretensioned such that they are immediately effective in transferring load. This tensioning can be verified by applying a load to the midspan of the cable and measure the deflection perpendicular to the cable. For a 17” (432 mm) long rope, a deflection of 1/4” (6 mm) under a 150 lb (68 kg) force will indicate that the required preload of 1000 lbf (454 kg) is present.





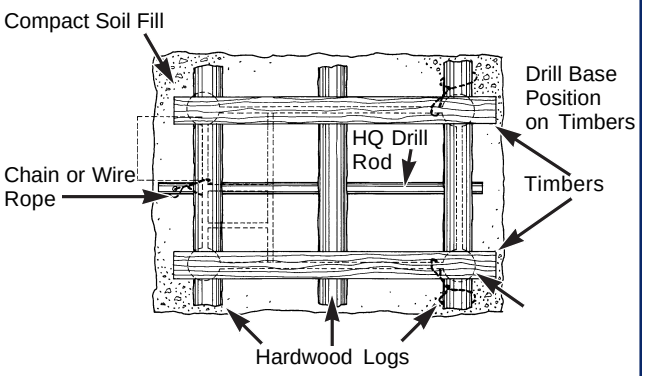
Ensure the drill is level in both directions and the levelling jacks have been securely clamped into the drill base.

Alternate Anchoring Methods

8. If the drill site is particularly hard and difficult to dig, an alternative pattern of anchoring the drill can be utilized. This would involve using three (3) - 10" (25 cm) minimum diameter hardwood logs (in good condition, ie: not rotting) buried just below the earths surface, cross ways at 90° to the final positioning of the drill. A 10' (3 m) HQ drill rod with attached chain should be positioned beneath and at 90° to the buried logs with the chain end of the rod at the mast end of the drill. The anchor chain should be tensioned back to the base at an angle to prevent the drill pushing itself off line when high bit loads are applied on angle holes.

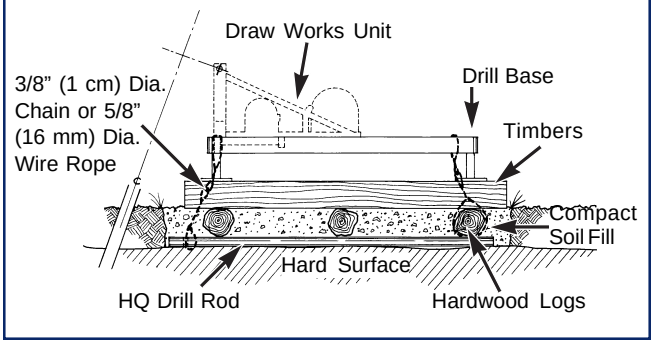
Anchoring with Compacted Back Fill

Top View



Mast End

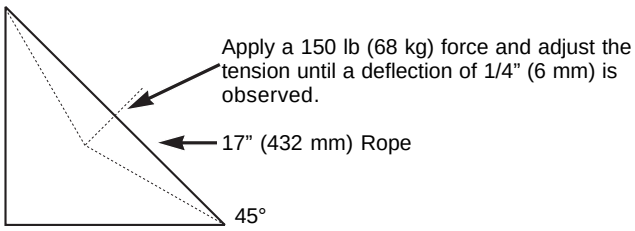
Side View



Ensure the drill is level in both directions and the levelling jacks have been securely clamped into the drill base.

9. Another pattern of anchoring when the site is difficult to dig is with the use of concrete in a shallow trench. Use four (4) pieces of 2' (0,6 m) minimum length scrap HQ drill rod with attached 3/8" (1 cm) diameter chain or 5/8" (16 mm) wire rope. The chain or wire rope should be long enough to have 5' (1,5 m) protruding after the trench has been filled. Place one piece of rod and chain or wire rope in each of the four (4) outer corners of the trench, beyond the levelling jacks. Fill the trench with concrete, covering the pieces of rod and chain or wire rope to surface level, keeping the protruding chain or wire rope ends free. The collar area for drilling vertical holes should be kept clear of concrete. Allow 12 hours for the concrete to cure. Next, position two (2) 10" x 10" (25 cm x 25 cm) timbers longitudinally under where the drill base levelling jacks will be positioned. Place the drill on the timbers. Use additional 3/8" (1 cm) diameter chain or 5/8" wire rope around each of the outer four (4) corners of the drill base. Attach each chain or wire rope to the free end of the chain or wire rope protruding from the concrete and tension the drill down with a come-along style winch, turnbuckle, etc.

   Chain or wire rope must be adequately pretensioned such that they are immediately effective in transferring load. This tensioning can be verified by applying a load to the midspan of the cable and measure the deflection perpendicular to the cable. For a 17" (432 mm) long rope, a deflection of 1/4" (6 mm) under a 150 lb (68 kg) force will indicate that the required preload of 1000 lbf (454 kg) is present.

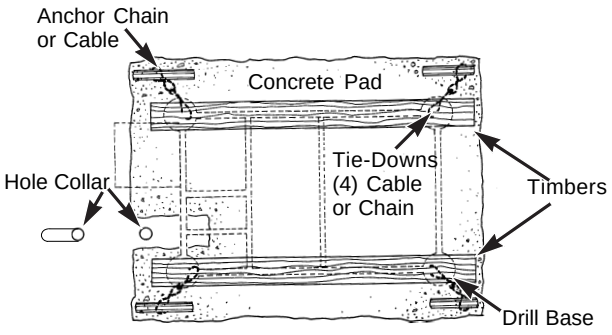


Ensure the drill is level in both directions and the levelling jacks have been securely clamped into the drill base.

Ensure the location of any obstacles at the rear of the drill will not be in the way of all proposed drill hole angles.

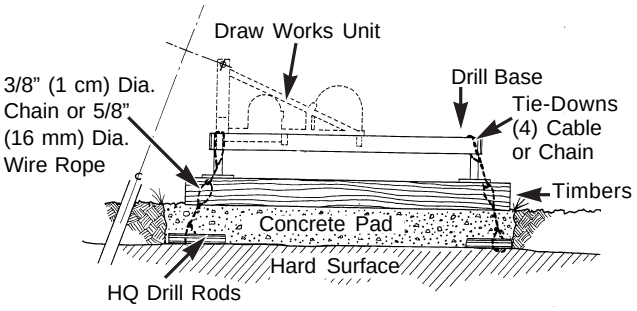
Anchoring on a Concrete Pad

Top View



Mast End

Side View



10. **Alternatively,** if the drill site is heavily forested, the LF70 can be anchored to the base of sturdy, healthy trees in the immediate area. Once again, the machine should be anchored so that the drill will not push itself off the hole when high bit loads are encountered.

11. **Burning Casing In** Experienced operators may find that burning a piece of casing into the ground may be the fastest means of anchoring the drill.

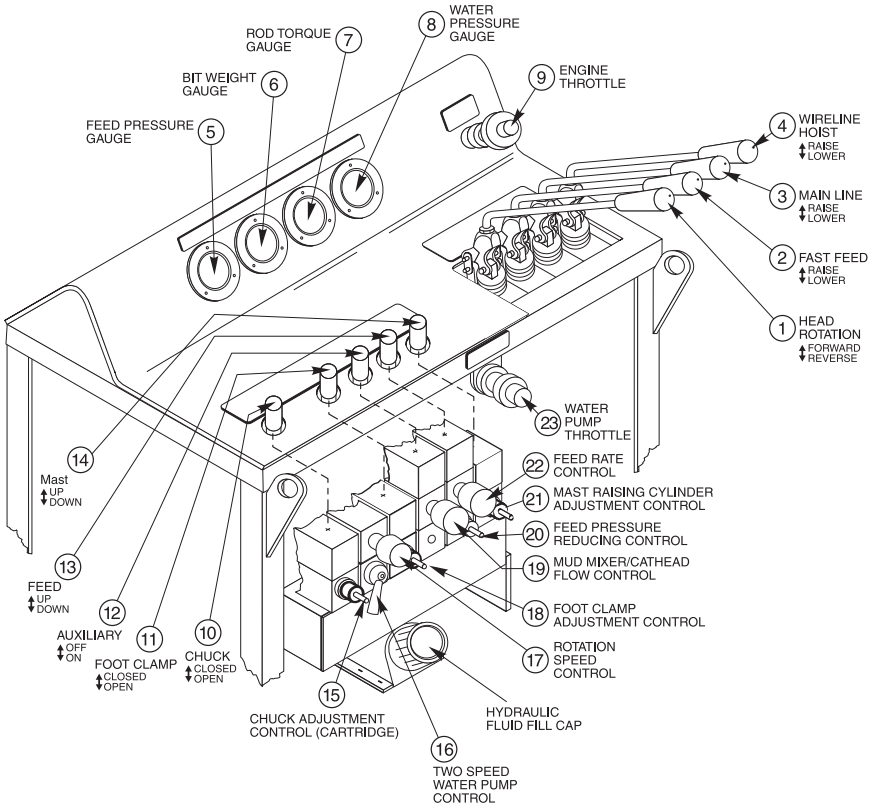
12. **Drilling and Insert Rockbolts** if on bedrock.

Start Up Procedures

1. Proceed to start the drill as follows, only after the pre start check has been completed.
2. Ensure the control panel levers and gear box selector are in the following position:

Chuck selector (10)	- Closed
Auxiliary selector (12)	- Off
Feed selector (13)	- Neutral (central position)
Head rotation lever (1)	- Neutral (central position)
Fast feed lever (2)	- Neutral (central position)
Main line hoist lever (3)	- Neutral (central position)
Foot Clamp (11)	- Closed
Wireline hoist lever (4)	- Neutral (central position)
Rotation speed (17)	- Fully counterclockwise (slow)
Feed rate (22)	- Fully clockwise (off)
Water pump throttle (16)	- Fully clockwise (off)
Drill head gear selector	- Neutral
Feed pressure reducing control (20)	- Fully clockwise (max)

⚠ WARNING **Before operating controls, know the functions.**



3. Turn the engine throttle (9) two turns counterclockwise.
4. Turn the engine ignition switch clockwise to the "on" position, then to start. When the engine starts, release the switch which will now return to the "on" position. Next, adjust the engine throttle (9) until a smooth idle rpm is obtained.

   If the engine fails to start, the ignition switch must be returned to the "off" position before a restart can be attempted. Follow the above procedures when attempting to restart the engine.

   Investigate why the engine will not start (i.e. fuel or electical problems) before cranking excessively.

⚠ WARNING **Excessive cranking can damage the electrical fuel solenoid or starter motor.**

5. Check the diesel engine oil pressure gauge and ensure this rises to its operating level. Minimum allowable oil pressure at idle is 10 psi (0.06 MPa). Minimum allowable oil pressure at rated rpm is 30 psi (12 MPa).
6. Allow the diesel engine to warm up for two minutes before gradually increasing the rpm.

If operating in extremely cold, ambient conditions, allow the engine at least seven minutes to warm up before increasing the rpm or placing any load on the machine.

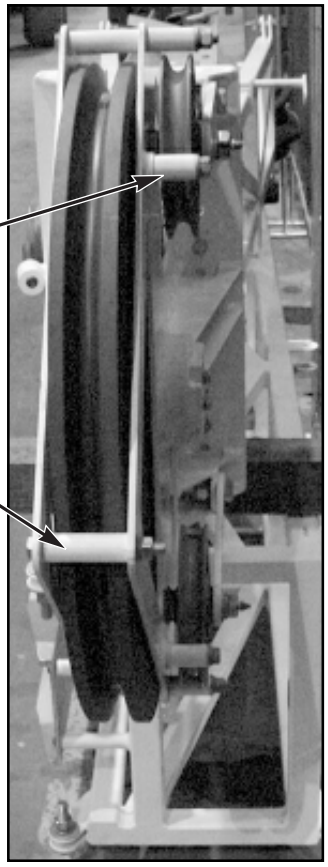
Raising the Mast (Mechanical Mast Raising "Standard")

1. Prior to starting the machine, ensure the drill is level, and firmly supported by the four leveling jack legs (ie. not resting on the wheels if these are left on the base). If there is any doubt that some weight may be on the tires, remove them to ensure the four leveling jack legs are supporting the drill in a level manner. Use timber planks under the four leveling jack legs if necessary.
2. Add the required mast sections (either upper and middle or upper only) and make sure they are firmly secured with their respective mounting bolts.
3. Route the main line hoist and wireline hoist cables through the sheave wheels of the crown block assembly, making sure to replace the cable retaining spacers and bolts.

Item 3

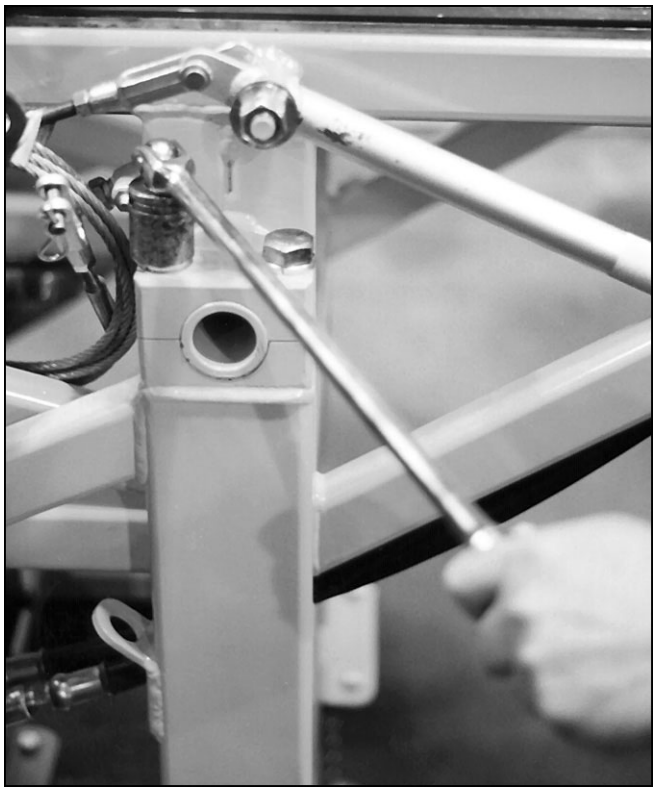
Wireline Cable Retainer Spacers and Bolts

Main Line Cable Retainer Spacers and Bolts



4. Secure the overshot and hoisting plug, if connected (or main line hoist and wireline hoist cables) to the mast, to prevent them from falling during the raising operation.
5. Start the drill as described in the previous section and stroke the drill head the entire length of its stroke, up and down, a few times. To accomplish this, raise the fast feed lever to stroke the drill head to the extended position and push the fast feed lever down to lower the drill head towards the base of the mast. This will eliminate any entrapped air from the feed cylinder, which will allow for a smooth mast raising.

6. Loosen the four bolts on the mast swivel mounting blocks (do not completely unscrew, loosen only two turns).



Item 6

⚠ WARNING **Ensure there are no overhead power lines, trees or structures which could foul the mast during the raising, drilling or lowering operations.**

7. Before raising the mast, loosen the capscrews which hold the mast support legs in their travelling position (do not remove completely). Accomplishing this step prior to raising the mast, will avoid any unnecessary delays in securing the mast support legs, once the tower has been raised.
8. Prior to raising the mast, make sure that all hoses, fittings and cables are free and will not get caught on anything during the raising operation.

9. Slowly begin to raise the mast by moving the mast raising control lever forward (away from the operator).

(**NOTE:** Actual equipment may not be exactly as shown)

Item 9

(**NOTE:** Actual equipment may not be exactly as shown)

Raising the mast should be accomplished in a gentle, smooth fashion. Avoid jerky and erratic stop and start motions.

Once mast raising has commenced, under no circumstances should any person or part there of, get under or perform any work in that area until the mast raising is complete (as detailed in this section) and the tower firmly secured by the mast support legs.

During the raising operation, double check that no hoses, fittings or cables are hanging up or getting caught.

10. Continue to raise the mast by holding the lever in the forward position (away from the operator) until the tower is in the vertical position with the lower section of the lower mast assembly resting against the drill base. In this position, the mast is slightly over centre.

11. Stop the diesel engine.

(**NOTE:** Actual equipment may not be exactly as shown)

Item 11

12. Once the mast has broken over centre, with the lower mast section resting against the drill base, release the outside (ie. furthest away from the control panel) mast support leg from its retaining bracket on the lower mast section and position it in its respective bracket on the rear of the drill base.
13. Secure the clamping jaw firmly.
14. Once the mast is firmly supported in a vertical position by the outside mast support leg, remove the inside mast support leg from its retaining bracket and position in its respective bracket on the drill base (do not tighten the clamping jaw set screw).
15. Next loosen the outside mast support leg clamping jaw set screw.
16. Restart the diesel engine and place the mast to the desired drilling angle by pulling the mast raising control lever towards the operator.
17. Once the desired angle has been reached, firmly secure the outside mast support leg clamping jaw set screw and locknut before doing the same to the inside mast support leg clamping jaw.
18. Retension the four mast pivot block bolts.

Raising the Mast (Hydraulic Mast Raising "Option")

Mast Raising/Lowering Selector Valve - This is a spring centered motor spool, four way, three position valve which either raises or lowers the mast assembly hydraulically when activated. The lever for this valve is situated under the control panel surface to prevent accidental actuation of selector valve. The front panel on the control console must be opened to access the lever for raising or lowering the mast.

Raising the Mast

1. Prior to starting the machine, ensure the drill is level, and firmly supported by the four leveling jack legs (i.e. not resting on the wheels if these are left on the base). If there is any doubt that some weight may be on the tires, remove them to ensure the four leveling jack legs are supporting the drill in a level manner. Use timber planks under the four leveling jack legs if necessary.
2. Add the required mast sections (either upper and middle or upper only) and make sure they are firmly secured with their respective mounting bolts.
3. Route the main line hoist and wireline hoist cables through the sheave wheels of the crown block assembly, making sure to replace the cable retaining spacers and bolts.
4. Secure the overshot and hoisting plug, if connected (or main line hoist and wireline hoist cables) to the mast, to prevent them from falling during the raising operation.
5. Start the drill as described in the previous section and stroke the drill head the entire length of its stroke, up and down, a few times. To accomplish this, raise the fast feed lever to stroke the drill head to the extended position and push the fast feed lever down to lower the drill head towards the base of the mast. This will eliminate any entrapped air from the feed cylinder, which will allow for a smooth mast raising.
6. Loosen the four bolts on the mast swivel mounting blocks (do not completely unscrew, loosen only two turns).

NOTE: Ensure there are no overhead power lines, trees or structures which could foul the mast during the raising, drilling or lowering operations.

7. Before raising the mast, loosen the capscrews which hold the mast support legs in their traveling position (do not remove completely). Accomplishing this step prior to raising the mast, will avoid any unnecessary delays in securing the mast support legs, once the tower has been raised.
8. Prior to raising the mast, make sure that all hoses, fittings and cables are free and will not get caught on anything during the raising operation.
9. Slowly begin to raise the mast by moving the mast raising control lever forward (away from the operator).

   Raising the mast should be accomplished in a gentle, smooth fashion. Avoid jerky and erratic stop and start motions.

WARNING **Once mast raising has commenced, under no circumstances should any person or part there of, get under or perform any work in that area until the mast raising is complete (as detailed in this section) and the tower firmly secured by the mast support legs.**
During the raising operation, double check that no hoses, fittings or cables are hanging up or getting caught.

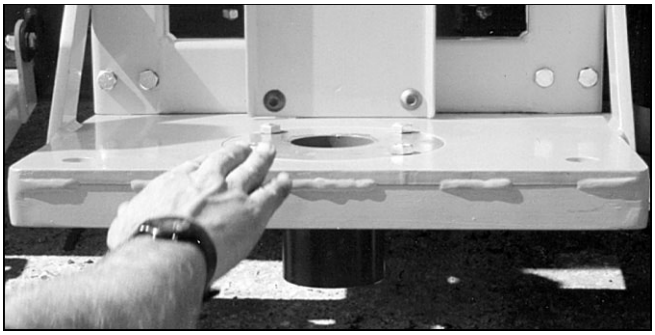
10. Continue to raise the mast by holding the lever in the forward position (away from the operator until the tower is in the vertical position with the lower section of the lower mast assembly resting against the drill base. In this position, the mast is slightly over centre.
11. Stop the diesel engine.
12. Once the mast has broken over centre, with the lower mast section resting against the drill base, release the outside (i.e. furthest away from the control panel) mast support leg from its retaining bracket on the lower mast section and position it in its respective bracket on the rear of the drill base.
13. Secure the clamping jaw firmly.
14. Once the mast is firmly supported in a vertical position by the outside mast support leg, remove the inside mast support leg from its retaining bracket and position in its respective bracket on the drill base (do not tighten the clamping jaw set screw).
15. Next loosen the outside mast support leg clamping jaw set screw.
16. Restart the diesel engine and place the mast to the desired drilling angle by pulling the mast raising control lever towards the operator.
17. Once the desired angle has been reached, firmly secure the outside mast support leg clamping jaw set screw and locknut before doing the same to the inside mast support leg clamping jaw.
18. Retension the four mast pivot block bolts.

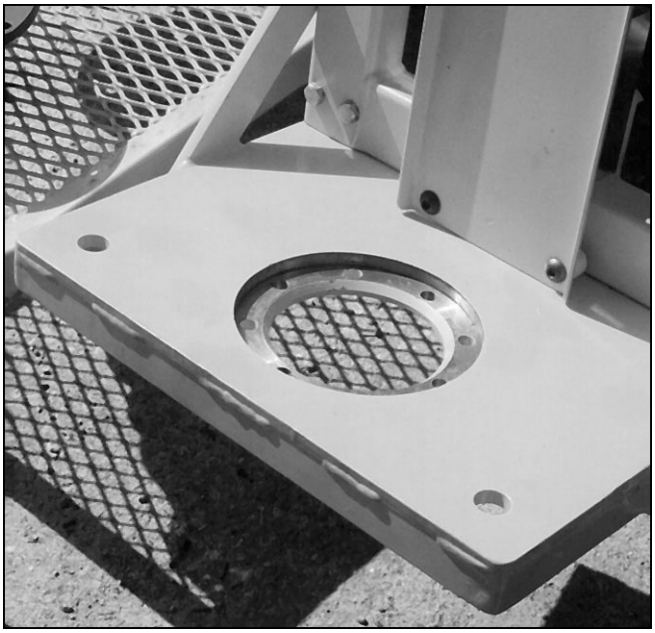
(**NOTE:** Actual equipment may not be exactly as shown)

Item 16

Collaring the Hole

The LF70 is supplied with a casing guide bushing and a casing adapter collar as standard. These two items are used when collaring a drill hole and fit into the spigot on the casing positioner base of the lower mast section.





WARNING **To avoid a possible pinch point, when installing the casing adapter collar into the casing positioner base, the casing adapter collar should be threaded onto the casing from the underside of the casing positioner base.**

Casing Guide Bushing

The bores of these bushings are very close to the O.D. of the particular casing string that is being used to collar the hole (ie. BW, NW, etc.). The casing guide bushing is designed to stabilize the casing string and maintain hole alignment. The casing guide bushing should be used throughout the entire casing run.

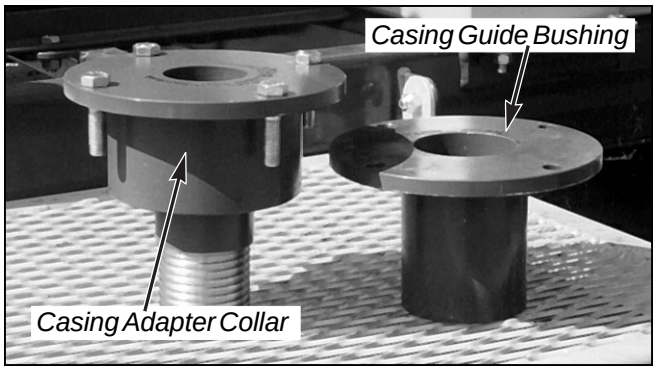
Casing should be firmly seated into bedrock before reducing to the coring system that will be used. As both the casing guide bushing and casing adapter collar are designed to be used together, operators should follow the procedures outlined in this section to ensure the drill is set up correctly.

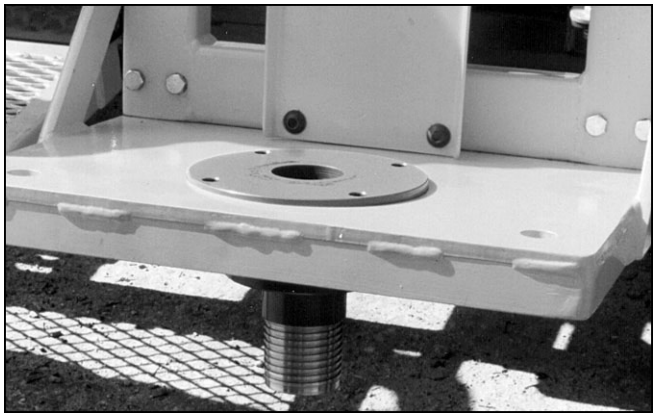
Casing Adapter Collar

The casing adapter collar has the same shoulder to shoulder length as the casing guide bushing. When drilling the casing, the operator should advance the casing joint he intends to disconnect at, until it is flush with the bottom of the casing guide bushing. Once the casing is firmly seated in bedrock (after the casing has been disconnected), the casing guide bushing is replaced with the casing adapter collar.

The previous step of drilling the casing joint to the bottom of the casing guide bushing will now allow the casing adapter collar to connect to the casing string and bolt to the lower mast casing positioner base.

Following this procedure will ensure that the LF70 is securely aligned onto the casing string which minimizes hole alignment problems as drilling progresses.





(**NOTE:** All above photos may not be exactly as shown)

Inserting the Core Barrel

1. Run the drill head to the base of the the mast and swing open the drill head.
2. Attach the water swivel or hoisting plug to the core barrel.
3. Attach the main hoist cable to the water swivel or hoisting plug bail.
4. Lift the main hoist lever which will raise the core barrel (guide the water swivel or hoisting plug into the rod slide when doing this) above the drill head.
5. Depress the main hoist lever to lower the core barrel assembly into the casing.
6. Securely clamp the core barrel above the casing adapter collar or foot clamp.
7. Remove the water swivel or hoisting plug from the core barrel and attach to drill rod.

8 Close drill head, attach drill rod to core barrel and close the chuck.

9. Remove core barrel clamp.

Rod Guides

Both the middle and upper mast sections have rod guides which are activated by cable from the operator's platform. This helps thread joint alignment when adding or removing rods from the hole.

Stacking Drill Rods

The lower end of rod should be placed on a suitable wooden platform covered with a heavy rubber mat located beside the drill. Stack the rods in lengths at an angle slightly steeper than the mast angle to ensure that they remain secure against the rod rack under their own weight.

Force on Diamond Bit

The force exerted on the diamond bit while drilling is approximately equal to the weight of the rods and the down force exerted by the hydraulic cylinder.

This force is difficult to measure directly but can easily be found by the following “OFF PRESSURE” method:

1. First, suspend the rods with the hydraulic head cylinder as follows:
   a) Move the Chuck Selector forward (closed) with the Fine Feed Rate Control Valve open, then move Feed Control Selector forward (feed up).
   b) Move the Feed Control Selector rearwards (centre position) then close the Fine Feed Control Valve.
   c) Move the Feed Control Selector rearwards (feed downward) and note the pressure on the Bit Weight Gauge.
2. Next, start drill string rotation, slowly bringing up to drilling rpm. Then, slowly open the Fine Feed Rate Valve as the rods are lowered, and the bit makes contact. The amount of the pressure reading decreases and can, for convenience, be called the “OFF PRESSURE”.
3. The OFF PRESSURE multiplied by the effective area of the hydraulic cylinder 7.06 sq in (45 sq cm) will give the downward force exerted on the diamond bit.

   EXAMPLE:

   Hydraulic Pressure w/rods suspended 1500 PSI (10.343 MPa)

   Hydraulic Pressure w/bit contacting bottom of hole 1000 PSI (6.895 MPa)

   Off Pressure is the difference 500 PSI (3.448 MPa)

   Total force on bit = 7.06 sq in x 500 PSI 3530 lbf.

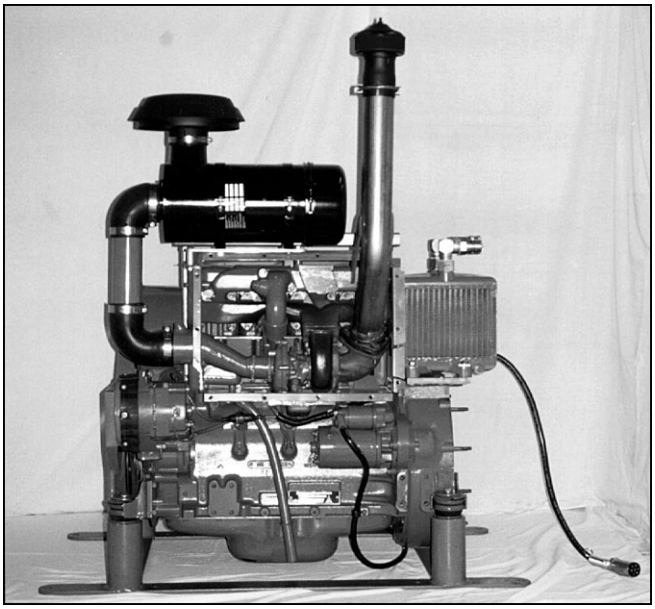
Bit Weight Table

Off Pressure PSI	Downward Force on Bit Lbf	kg
100	706	320
150	1059	480
200	1,412	640
250	1,765	800
300	2,118	961
350	2,471	1 121
400	2,824	1 281
450	3,177	1 441
500	3,530	1 601
550	3,883	1 761
600	4,236	1 921
650	4,589	2 082
700	4,942	2 242
750	5,295	2 402
800	5,648	2 561
850	6,001	2 722
900	6,354	2 882
950	6,707	3 042
1,000	7,060	3 202
1,050	7,413	3 362
1,100	7,766	3 522
1,150	8,119	3 683
1,200	8,472	3 843
1,250	8,825	4 003
1,300	9,178	4 163
1,350	9,531	4 323
1,400	9,884	4 483
1,450	10,237	4 643
1,500	10,590	4 804
1,550	10,943	4 964
1,600	11,296	5 123
1,650	11,649	5 284
1,700	12,002	5 444
1,750	12,355	5 604
1,800	12,708	5 764

Shut Down Procedures

1. If the drill string is rotating, close the fine feed valve and allow any drill string compression or stretch to "drill out". You will notice the bit weight gauge needle begin to rise as the weight comes off the bit.
2. Return the fine feed selector to neutral (centre position) and crack open the feed rate control.
3. Lower the diesel engine rpm to about half, then wind the rotation speed control counterclockwise to reduce the drill string rpm. Next, feather the rotation control level back to neutral making sure the reverse lockout is in position, to prevent the lever from going into reverse.
4. Use the fast feed lever to raise the drill head to break the core and pull the bit at least 12 in (30.5 cm) off bottom.
5. Allow the fluid pump to flush the hole for about 5 minutes before turning the water pump throttle completely clockwise to stop the fluid pump.
6. Place the auxiliary selector in the off position.
7. Reduce the diesel rpm and allow the unit to idle for 5 minutes. This is very important. It allows the turbocharger sufficient time to slow down prior to stopping the engine.
8. Turn the ignition switch counterclockwise to the off position to stop the diesel engine.

⚠ WARNING **If an emergency shutdown is required, depress the EMERGENCY STOP immediately, regardless of the drilling operation.**



(**NOTE:** Actual equipment may not be exactly as shown)

Deutz

Lowering the Mast (Hydraulic Mast Raising Version)

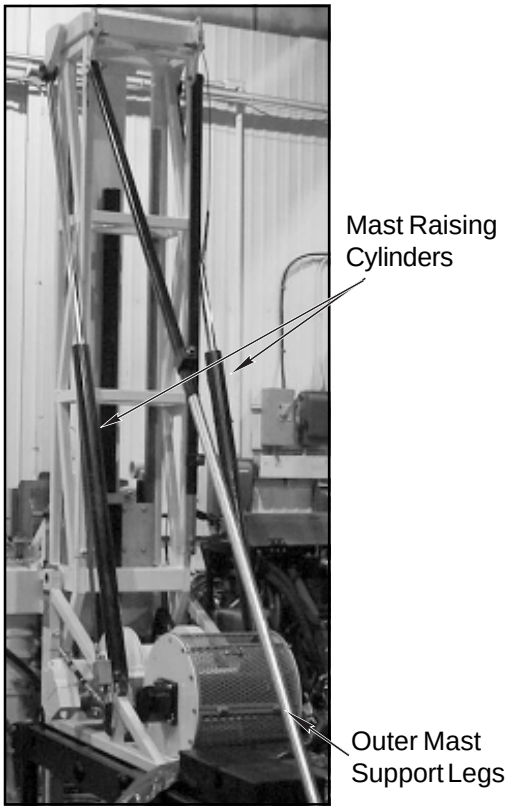
CAUTION **Under no circumstances should any individual, or part there of, be directly underneath the mast when attaching the outside mast support leg.**

WARNING **Ensure that no one is in the vicinity of the mast lowering area and that there are no overhead power lines, trees or structures that may foul the mast during the lowering operation.**

1. Stop the diesel engine.
2. Loosen the clamping jaw set screw on the inside mast support leg (ie. closest to the diesel engine) and detach the sliding section from the front of the drill base. Now, push the telescoping inner support leg section into the outer support leg section and fold the support leg back to its travelling position on the lower mast section and retain it in the bracket provided.
3. Repeat step 2 with the outside mast support leg (ie. furthest from the diesel engine) and retain it in its travelling position.
4. Loosen the four mast swivel mounting block bolts, two (2) turns.
5. Start the diesel engine and adjust to 1500 rpm. Slowly move the raising/lowering control lever back towards the operator. This function will retract hydraulic cylinders, lowering the mast.

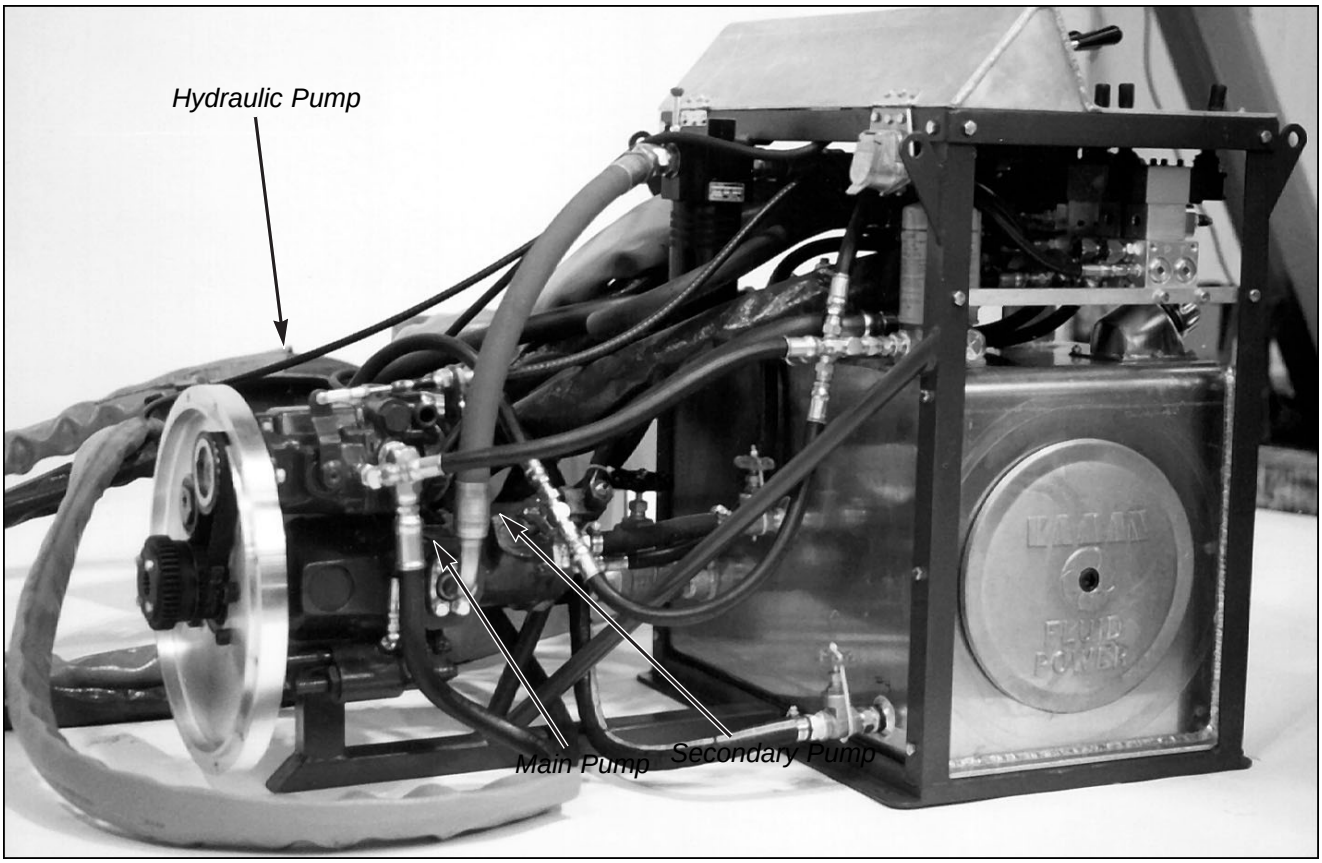
   Mast lowering should be accomplished in a smooth, steady fashion. Avoid jerky stop-start motions.

   When lowering the mast, ensure no hydraulic hoses, fittings or cables will get caught or snagged during this operation, or that the hoisting and wireline cables and accessories are firmly secured to the mast and cannot fall off.
6. Once the mast has come to rest on its support brackets at the front of the drill base, remove the spacers and bolts from the cable retainers on the crown block assembly and remove the main line hoist and wireline hoist cables.
7. Next, remove the middle and upper mast sections, then tighten the four mast swivel mounting block bolts.



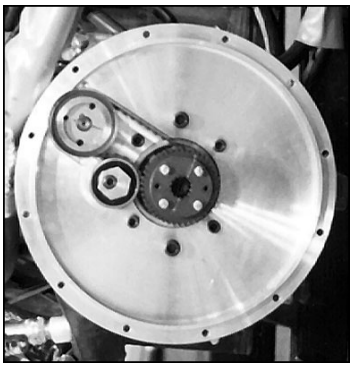
Hydraulic Explanation

Three separate hydraulic circuits transmit the output power of the diesel engine to the various drill functions. Following is a description of each circuit.

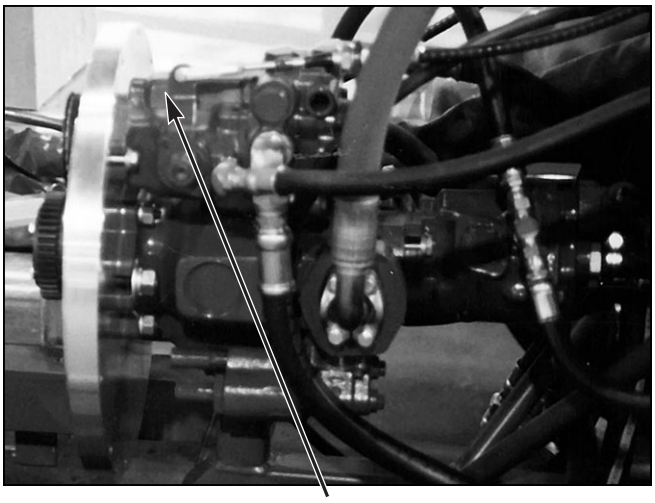


Drive Source

The hydraulic pumps are driven by a toothed composite (synthetic) adapter plate (flywheel coupling) which is bolted to the flywheel of the diesel engine. The main pump has a toothed driven sprocket mounted on its input shaft which fits into the composite flywheel adapter plate, with the pump flange being bolted to an aluminum bell housing adapter plate. The secondary pump is piggybacked to the main pump and connected by a through shaft.



Drive for the fluid pump hydraulic power source is via a toothed timing belt inside the aluminum bell housing pump mounting plate. Behind the toothed driven sprocket on the main pump input shaft is a toothed pulley to which a timing belt is connected. This in turn powers the hydraulic pump (fluid pump), which is mounted towards the upper outside diameter of the aluminum bell housing pump mounting plate.



Hydraulic Pump (Fluid Pump)

Primary Circuit

CAUTION **If the gate valves are ever closed to perform any work on the hydraulic system, ensure they are fully opened and resealed in that position, with the hydraulic reservoir topped to correct level before operating the drill.**

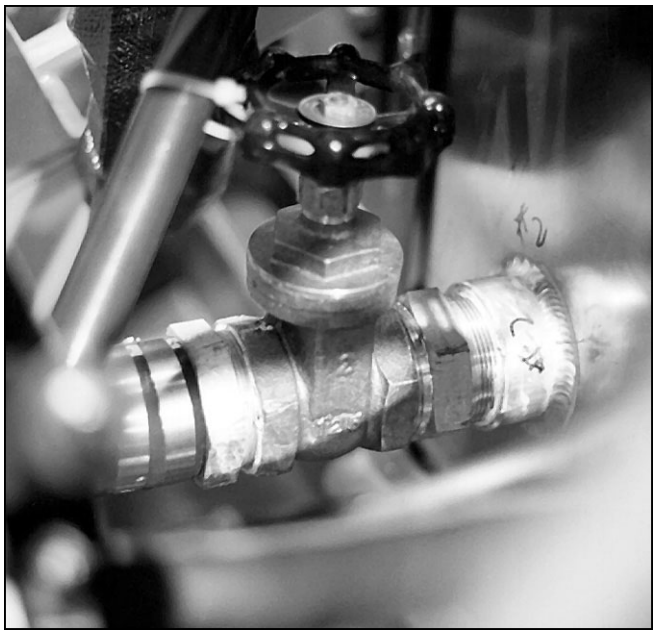
Use only the correct grade of clean, hydraulic oil from uncontaminated containers to refill the reservoir.

Rotation, Fast Feed. Main Line Hoist, Wireline Hoist.

The primary pump is of a variable displacement, axial piston, pressure compensated design with a low pressure standby. This is directly driven through a toothed gear on its input shaft which is

powered by a composite adapter plate (flywheel coupling) bolted to the flywheel of the diesel engine.

This pump features a 2" (50 mm) inlet hose which is connected to a gate valve on the hydraulic reservoir. This gate valve allows the operator to isolate the hydraulic reservoir fluid, should he wish to work on a particular section of the circuit. All three gate valves are sealed with a cable tie, in the open position, when the LF70 leaves the factory.

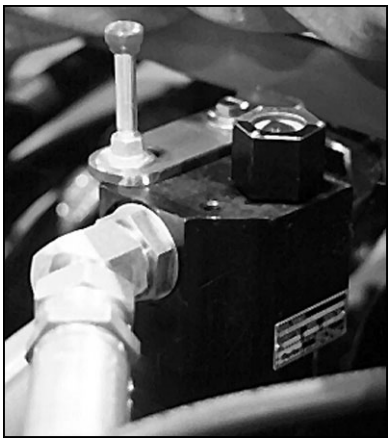


Gate Valve

The internal inlet of the hydraulic reservoir for the primary pump features a 100 mesh strainer which is fitted with a 3 psi (20 kPa) vacuum bypass valve. This will allow a full flow of oil to the primary pump if the strainer becomes clogged or when starting in extremely cold climatic conditions. The strainer is removable and can be washed and reused if it becomes clogged.

The outlet of the primary pump goes directly to a high pressure filter (10 micron absolute rating) which is fitted with a clogging indicator (this should only be monitored at operating temperature, as cold oil may give a false reading). Oil from the high pressure filter is then directed to the inlet section of the main valve bank which is fitted with a rapid response relief valve, factory set at 3600 psi (24.8 MPa). All spools within the main valve bank are of closed centre design.

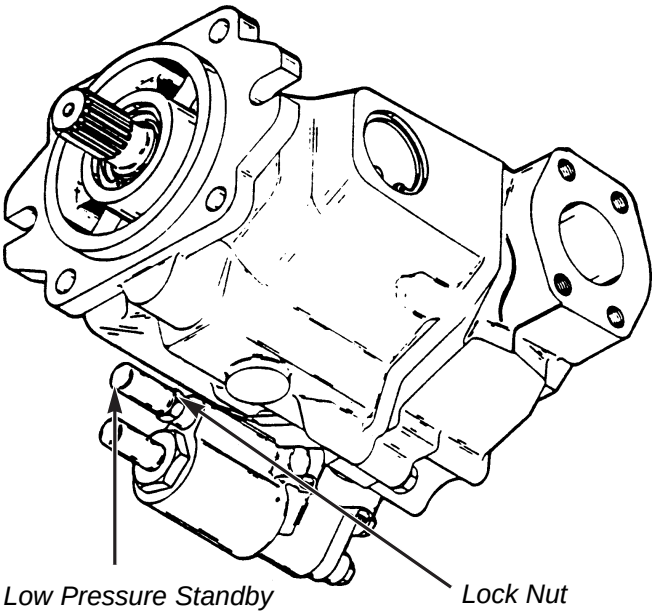
When the drill is initially started, all levers on the main valve bank should be in the neutral position. As these are closed centre valves, pressure will immediately begin to build up. A signal is, however, transmitted from the main valve bank to the low pressure standby feature on the primary pump. This causes the primary pump to destroke itself to maintain 200 psi (1.4 MPa) in this circuit. The low pressure standby feature is attached to the



Filter and Clogging Indicator

bottom of the primary pump and is the upper (ie. closest to the pump) adjustment screw. This is factory set at 200 psi (1.4 MPa).

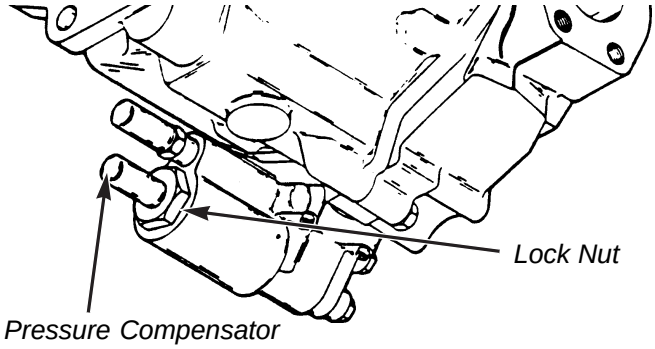
If the low pressure standby feature requires adjustment, the pressure can be read from the rod torque gauge. Setting of the low pressure standby must be accomplished with all main valve bank levers in neutral and the diesel engine at idle. Correct setting is 200 psi (1400 kPa).



Primary Pump
(Variable Displacement Axial Piston)

Maximum pressure of the primary pump is limited by the pressure compensator which is factory set at 3500 psi (24.1 MPa). This is located directly beneath the low pressure standby adjustment on the bottom of the primary pump and is the adjustment furthest from the pump.

NOTE: If the engine starts to labour when increasing pressure, you may need to increase the main relief setting a little above compensator as detailed in the following section.



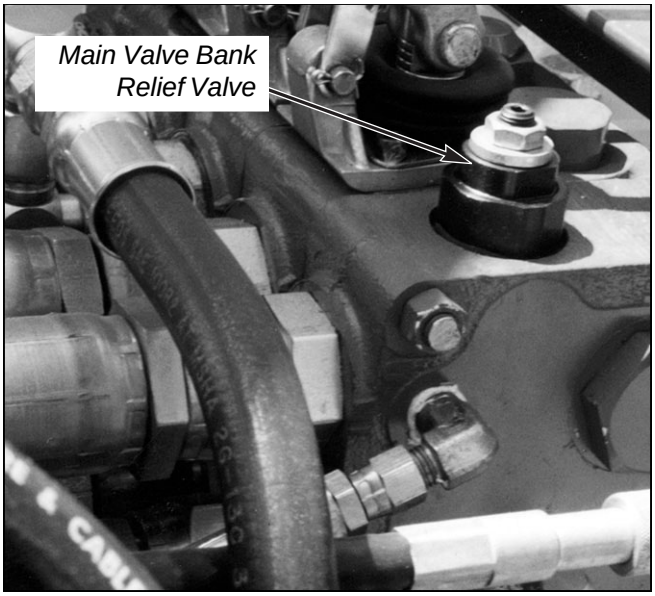
Primary Pump
(Variable Displacement Axial Piston)

If the pressure compensator requires adjustment, stop engine, uncouple one of the main quick couplers at the main rotation motor, start engine and engage the rotation direction control lever. This will dead head the main pump. The pressure can be read from the rod torque gauge. Correct setting is 3500 psi (24.1 MPa) maximum. To increase, loosen lock nut turn adjustment screw clockwise. To decrease, turn adjustment screw counter-clockwise.

Main Valve Bank

The main valve bank controls the functions of rotation, fast feed, main line hoist and wireline hoist. These functions are protected from pressure spikes by a quick response relief valve located in the inlet section of the main valve bank. This is factory set at 3600 psi (24.8 MPa) which is 100 psi (0.7 MPa) above the pressure compensator setting of the primary pump.

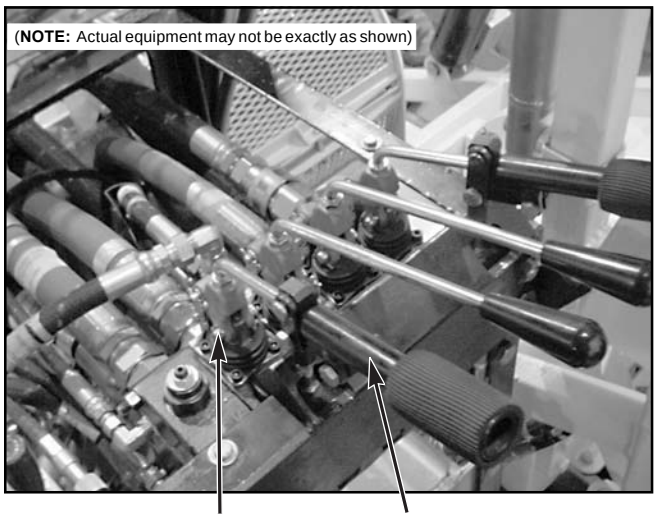
If the relief valve in the main valve bank ever requires adjustment, first uncouple one of the main quick couplers at the head rotation, start engine and engage rotation direction control lever. This will dead head the main pump. Ensure that the primary pump pressure compensator has been correctly adjusted to 3500 psi (24.1 MPa) as detailed in the previous section. Next, slowly wind out (counterclockwise) the relief valve adjusting screw until the diesel engine begins to labour heavily (this signals that the relief valve setting has reached the pump compensator setting and oil is now passing over the main relief valve instead of the pump compensating). Once this occurs, wind the relief valve in (clockwise) half a turn. This will set the main valve bank relief valve approximately 100 psi (0.7 MPa) above the pump compensator setting.



Main Valve Bank

Rotation Circuit

When rotation is initiated, full primary pump output (43 gpm - 163 L/min) is directed to the rotation motor via the rotation spool on the main valve bank. This is a detented, three position spool with lockout. The lockout is to prevent accidentally shifting from forward rotation directly into reverse which could cause the rod string to back off down the hole.



Rotation Spool with Lockout

Rotation Motor

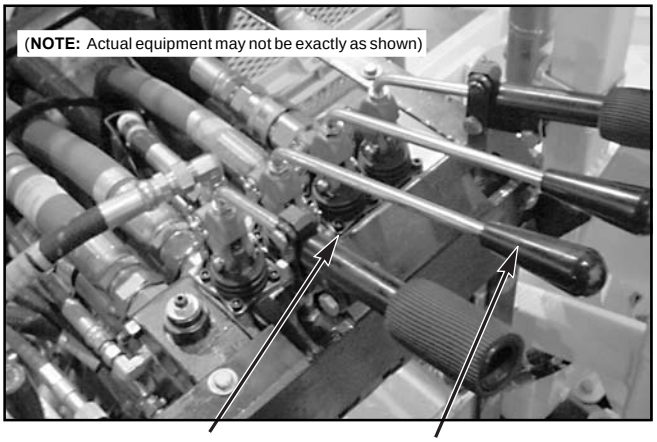
The rotation motor is a variable displacement, bent axis design with hydraulic control of the swash plate (ie. the displacement of the motor can be adjusted from minimum to maximum by adjusting the rpm control on the control panel). Turning the rpm control fully clockwise will place the motor on minimum displacement (ie. maximum rpm, conversely, counter-clockwise movement of the rpm control will allow the motor to shift from minimum displacement towards maximum displacement, thus decreasing the spindle rpm and increasing the available torque).

Maximum pressure within the rotation circuit is limited by the pressure compensator setting of the primary pump (ie. 3500 psi - 24.1 MPa). The pressure within the rotation circuit is displayed on the rod torque gauge on the control console which monitors the pressure within the main valve bank.

rpm Control

Fast Feed Circuit

The fast feed section of the main valve bank controls the rapid traverse of the drill head. This mode is normally used for rechucking at the completion of the core run or for locating the drill head in a desired position on its feed stroke. This valve spool is a spring centred, 3 position design with a closed centre. Full primary pump output (43 gpm - 163 L/min) can be directed to the feed cylinder through this spool. Pressure within the fast feed circuit is limited to 2500 psi (17.2 MPa) by work port relief valves. These are located on both "A" and "B" ports of the fast feed valve section and are nonadjustable.

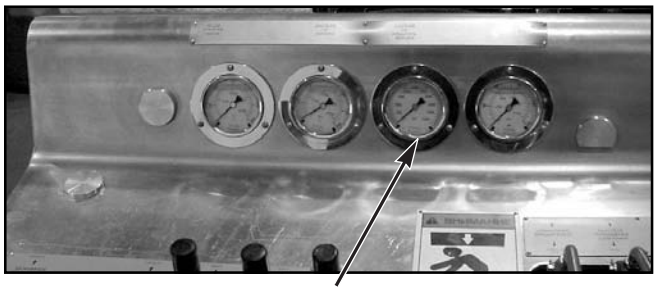


Port Relief Valve *Fast Feed Valve Spool*

The function of the work port relief valves is to protect the feed cylinder from over pressurization.

The "A" and "B" ports of the fast feed valve section are plumbed directly to a manifold at the rod end (base) of the feed cylinder. The feed cylinder is a double acting design which features internal porting to direct oil either above or below the cylinder piston, depending upon whether extension or retraction is desired.

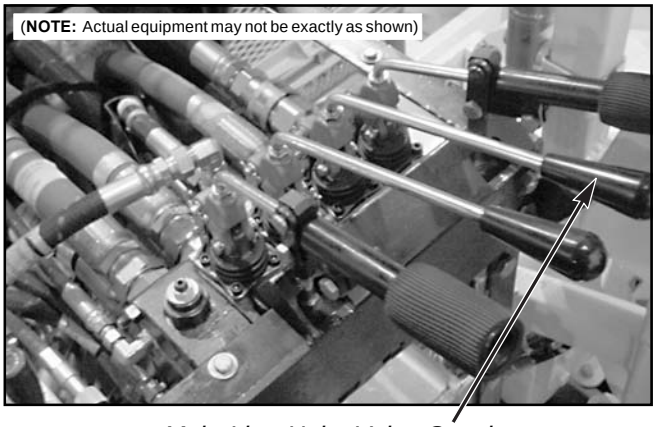
Also plumbed into the fast feed circuit is the fine feed circuit. The fine feed circuit is a function of the secondary pump and is controlled by a 3 position, closed centre, detented selector valve. When in neutral, the fine feed valve will not allow oil from the main valve bank fast feed circuit to enter the fine feed circuit due to its closed centre. Pressure within the fast feed circuit is monitored on the rod torque gauge on the control console.



Rod Torque Gauge

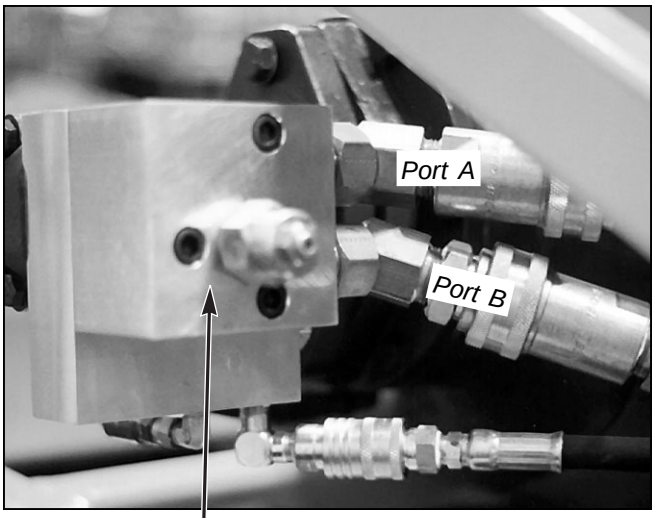
Main Line Hoist Cable Circuit

This is a spring centred, 3 position, closed centre valve spool, which can receive full primary pump output (43 gpm - 163 L/min).



Main Line Hoist Valve Spool

Full system pressure of 3500 psi (24.1 MPa) is available within the main line hoist circuit. The main line hoist circuit incorporates a counterbalance valve on the exhaust oil side of the hoist motor (when in the lowering mode). This valve is normally closed and will not allow the hoist to lower until a positive pressure is applied to the motor "A" port (ie. to lower the load). When the hoist lever is returned to neutral, the counterbalance valve will once again close and isolate the hoist motor to prevent loads running away.



Main Line Hoist Counterbalance Valve

The main line hoist planetary reduction assembly also incorporates a spring applied, hydraulically released brake. This locks the hoist assembly either the "A" or "B" port of the hydraulic motor is required to release the brake to allow the hoist to be raised or lowered.

As a third measure of preventing hoist overrun, the planetary gear assembly incorporates a sprag type bearing. This ensures that the main line hoist hydraulic motor must be powered ahead of hoist drum rotation (ie. if the hoist drum rotation begins to overrun the hydraulic motor, the sprag bearing will lock).

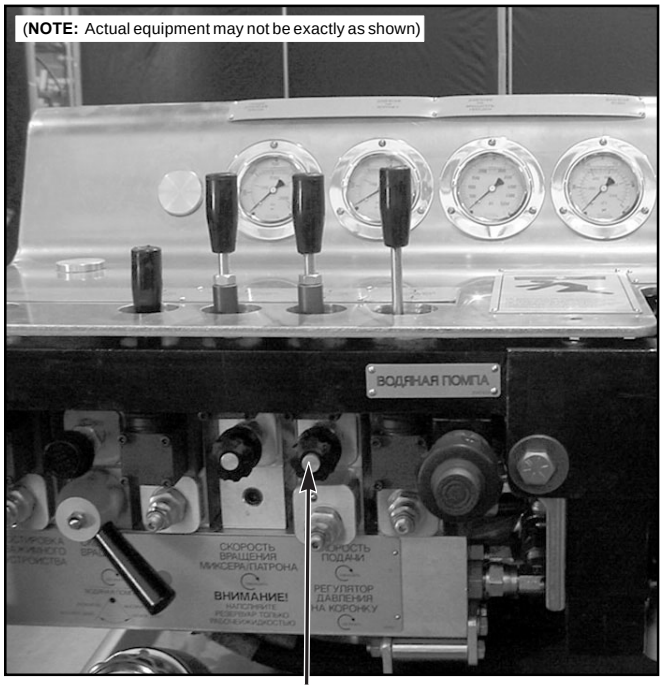
NOTE: Because of this circuit and the built in logic to pay out hoist cable as the drill head feeds down, it is very important that the feed rate valve is left open when each drilling run is completed, and the fine feed is turned off with the fine feed selector valve.

If the feed rate valve was to be closed, pressure could be trapped within the hoisting circuit, holding the spring applied brake "off" and also the pilot check valves "open". This scenario would not allow correct hoist brake functioning and the hoist may not hold the rods from falling back down the drill hole.

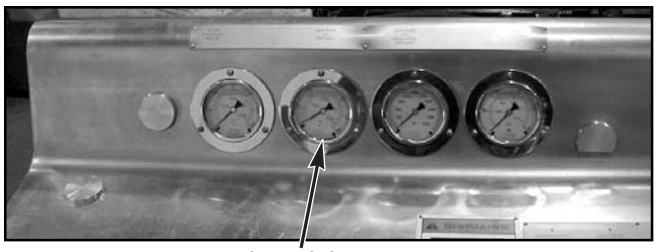
CAUTION **When hoisting or lowering rods, make sure the main hoisting cable is in tension before opening the chuck. Failure to do so could result in the hoist slipping and the rods dropping uncontrollably. Damage could result to the hoist and chuck. Personal injury could result. A simple method of ensuring all oil is bled from the hoist circuit is to observe the bit weight gauge on the control console. When this drops to zero, there is no residual pressure in the hoist circuit. Hoisting can now be undertaken with the spring applied brake and pilot operated check valves controlled from the main line hoist lever on the main valve bank and not the fine feed circuit.**

When in the drilling mode, the main line hoisting cable is connected to the water swivel bail. A slight tension is kept on the cable to prevent rod whip above the drill head. During drilling operations, with the drill head feeding down, a means of allowing the hoisting cable to unspool under tension has been incorporated into the main line hoisting circuit.

When "fine feeding down" (selector valve is in down direction and feed rate flow control valve is partly open) or in the drilling mode, a signal is sent to a shuttle valve mounted in the hoist motor manifold block. This signal moves the shuttle valve and allows a flow of oil to release the spring applied brake on the hoist. Oil is also directed to open the two pilot operated check valves in the hoist manifold block. When this signal is applied, the hoist is free to unspool, as the hydraulic motor can now bypass oil from the "A" and "B" port, due to the pilot operated check valves being open in conjunction with the spring applied brake being released. Tension is kept on the hoisting cable due to internal friction of the 16:1 (nominally for Geroler type motor) mechanical planetary reduction in the hoist drum and recirculation of hydraulic oil between the "A" and "B" ports of the large displacement main line hoist hydraulic motor.



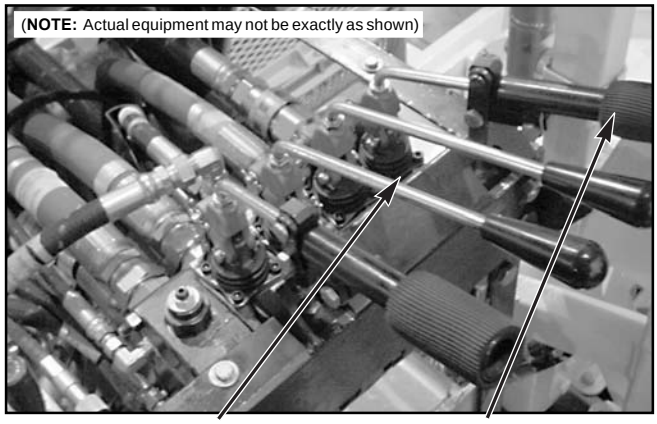
Feed Rate Valve



Bit Weight Gauge

Wireline Hoist Circuit

The wireline hoist spool is the final function circuit of the main valve bank. This controls the hoisting or lowering of the wireline cable. The valve spool for this section is of a closed centre, 3 position, spring centred design. The maximum pressure within this circuit is limited to 2200 psi (15.2 MPa) by work port relief valves on the "A" and "B" ports of the valve spool.



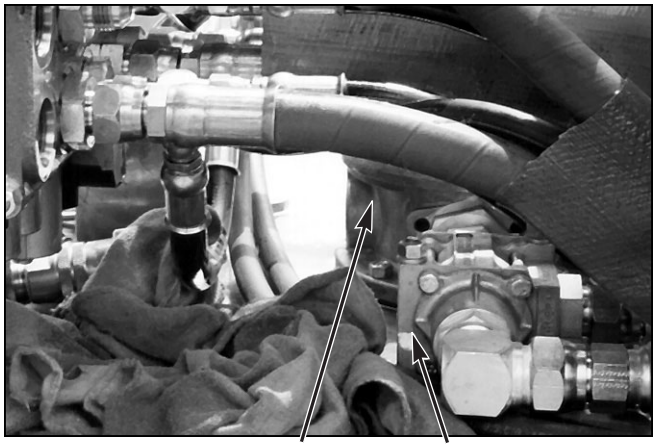
Port Relief Valve *Wireline Hoist Valve Spool*

The wireline hoist is protected from overrun by a counterbalance valve which is located on the motor exhaust oil port when in the lowering mode.

This valve is in the closed position when the wireline hoist lever is in the neutral position, which isolates the wireline hoist motor. A positive pressure is required from the lowering side of the spool to open the counterbalance valve and allow a load to be lowered. If the load begins to overrun the hoist (ie. when lowering an inner tube assembly into a dry hole on the overshot), the counterbalance valve will close, preventing the load from running away.

Primary Circuit Return Oil

Return oil from the primary circuit (rotation, fast feed, main line hoist, and wireline hoist) valve functions is directed to a thermal metering valve.

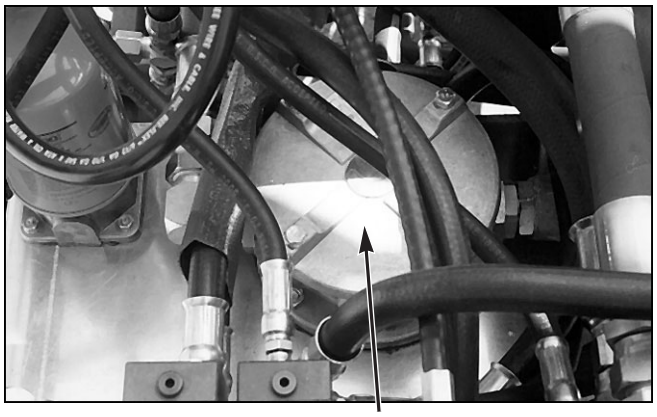


Main Return Line Filter *Thermal Valve*

When the oil is below operating temperature, this valve is closed and directs the oil to the main return line filter. When hydraulic oil temperature rises to 100°F (38°C), the thermal valve begins to open and redirects oil to the heat exchanger. Full flow through the thermal valve to the heat exchanger is achieved at 140°F (60°C). The thermal metering valve also incorporates a pressure relief valve which is designed to protect the heat exchanger, should a restriction build up in the circuit. This is set at 75 psi (0.5 MPa), 50 psi (0.3 MPa) cracking and will direct all oil to the main return filter should this pressure be reached.

After passing through the heat exchanger (if at operating temperature) or coming direct from the thermal valve (if below operating temperature), the exhaust oil from the main valve bank is then directed to the main return filter.

This is a 10 micron assembly located in the top of the aluminium hydraulic reservoir. A clogging indicator and full flow bypass valve are included in this assembly.

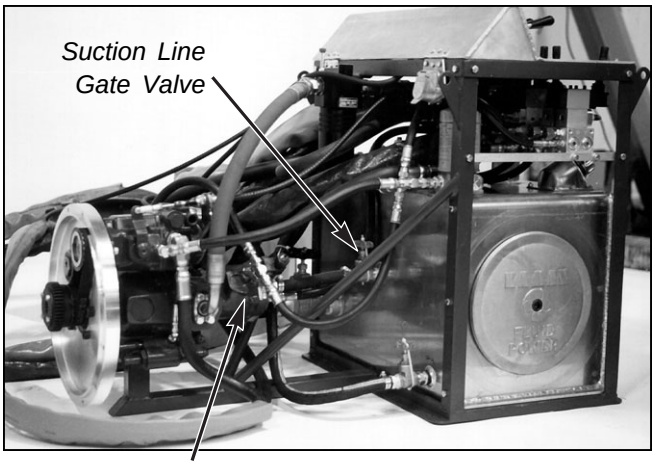


Main Return Line Filter

Secondary Circuit

The secondary circuit functions, comprising of the feed rate control valve, fine feed mode selector (up, down or neutral), auxiliary circuit (mud mixer on-off), rotation speed control and chuck control (open, close) are supplied with oil from the secondary pump.

This is piggybacked to the primary pump being driven by a through shaft, and is an open loop circuit.



Secondary Pump (Variable Displacement Axial Piston)

CAUTION **If the gate valves are ever closed to perform any work on the hydraulic system, ensure they are fully opened and resealed in that position, with the hydraulic reservoir topped to the correct level before operating the drill. Use the correct grade of clean, hydraulic oil from uncontaminated containers to refill the reservoir.**

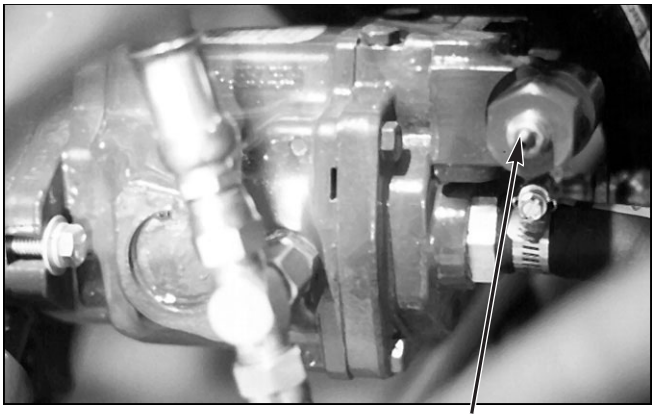
The suction inlet for the secondary pump features a 100 mesh strainer located inside the aluminium hydraulic reservoir (with 3 psi - 0.02 MPa vacuum bypass valve) and an external gate valve to isolate the reservoir, should the system require maintenance. Maximum output from the secondary pump is 11 gpm (41,6 L/min).

The secondary pump is of an axial piston pressure compensated design. The pressure within this circuit is limited to 2000 psi (13.8 MPa) by the compensator on the pump. This is the vertical adjustment screw, located on the rear of the secondary pump. To set the secondary pump compensator, position the secondary circuit levers in the following positions.

Fine Feed Control Lever - Neutral (central position)

Auxiliary Control (Mud Mixer) Lever - Off

Chuck Control Lever - Closed



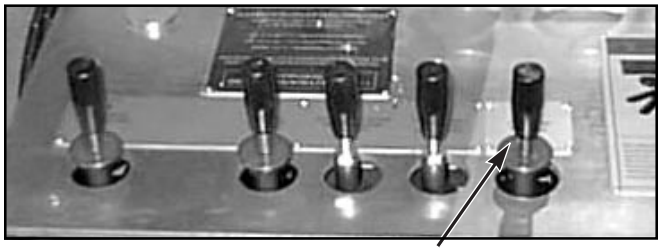
Compensator Adjustment Screw

Monitor the feed pressure gauge when setting the secondary pump compensator to its correct pressure of 2000 psi (13.8 MPa), for most drilling operations.

Oil enters the secondary circuit manifold from the secondary pump on the right hand side when viewed from the operator's platform. All valves on the secondary circuit manifold are of closed centre design.

Mast Raising/Lowering Selector Valve

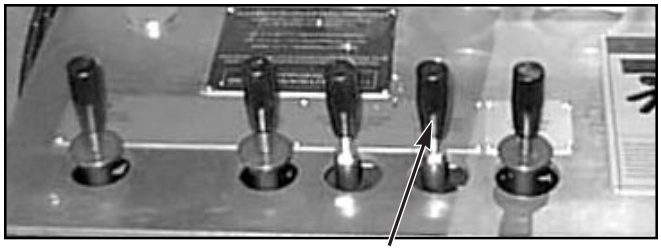
- This is a spring centered motor spool, four way, three position valve which either raises or lowers the mast assembly hydraulically when activated. Comes with a mechanical “lever lockout” device to prevent accidental actuation of selector valve. Lift to shift lever for raising or lowering mast.



Mast Raising/Lowering Selector Valve

Feed Selector Valve

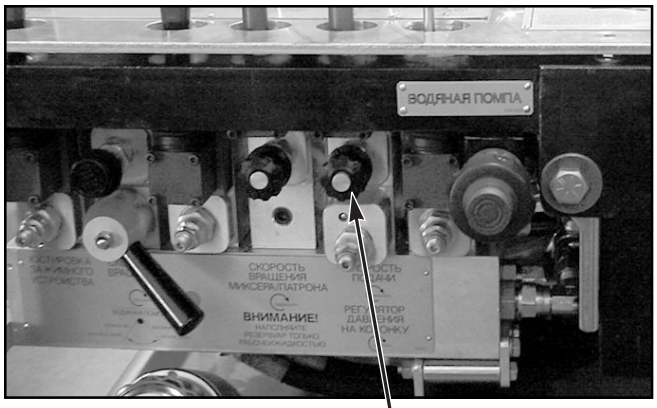
- This is the first valve (when viewed from the right in the operator's position) on the secondary circuit manifold. It is a four-way, three position, detented valve and controls the fine feed mode in either the "up" or "down" direction.



Feed Selector Valve

Fine Feed Flow Control Valve

- Situated below the fine feed selector valve and accessible from the front



(**NOTE:** Actual equipment may not be exactly as shown)

Feed Rate (Fine Feed Flow Control Valve)

⚠ WARNING **Never let the "bit weight" pressure fall below 200 psi (1400 kPa) during fine feed down operations, as this will prevent the hoisting cable (which is attached to the water swivel bail) from unspooling as the drill head advances. This situation could cause both equipment damage and personal injury.**

Because of this circuit and the built in logic to pay out hoist cable as the drill head feeds down, it is very important that the feed rate valve is left open when each drilling run is completed, and the fine feed is turned off with the fine feed selector valve.

(See photo reference - page 5-16)

If the feed rate valve was to be closed, pressure could be trapped within the hoisting circuit, holding the spring applied brake "off" and also the pilot check valves "open". This scenario would not allow correct hoist brake functioning and the hoist may not hold the rods from falling back down the drill hole.

A simple method of ensuring all oil is bled from the hoist circuit is to observe the bit weight gauge on the control console.

(See photo reference - page 5-16)

When this drops to zero, there is no residual pressure in the hoist circuit. Hoisting can now be undertaken with the spring applied brake and pilot operated check valves controlled from the main line hoist lever on the main valve bank and not the fine feed circuit.

of the hydraulic module, is the fine feed flow control valve.

This rotary valve controls the penetration rate (weight on bit) when the fine feed selector valve is in the "down" mode. Conversely, if the fine feed selector valve is in the "up" mode, the fine feed flow control valve will control the rate at which the drill head retracts (ie. back reaming). Turning the rotary control counterclockwise, increases the rate of penetration (weight on bit). The relationship between the fine feed flow control valve and the "weight on bit" gauge on the control panel is evident as this valve is adjusted.

This valve has an adjustable orifice which meters oil from the "T" port of the fine feed selector valve (piston end when in the down mode) and is known as the bleed off pressure. If the valve is only cracked slightly (ie. counterclockwise), the volume of oil escaping from the low pressure side is minimal, which translates to a slow rate of penetration and bit weights. The bit weight gauge is plumbed in between the "T" port of the fine feed selector valve and the feed flow control valve. In the above scenario, we are only allowing a small volume of oil to escape from the feed cylinder. This will create only a slight pressure differential between the rod (pressure in) and the piston (pressure out) end of the cylinder. This slight pressure differential will register as a small reduction in the value displayed on the bit weight gauge.

As the fine feed flow control valve is opened further (counterclockwise rotation), more oil is allowed to escape from the (piston side) end of the cylinder. This increased flow translates to a greater pressure differential which will register as a larger drop in the value displayed by the bit weight gauge.

The "bit weight" pressure gauge should never be allowed to fall below 200 psi (1.4 MPa). If it drops below this value, the signal to release the main line winch spring applied brake and to open the main line hoist motor pilot check valves will be lost. This will result in the main line hoist drum, once again, becoming locked (spring brake applied, pilot check valves closed) and the hoisting cable (which is attached to the water swivel) unable to feed out as the drill head advances down.

If, for example, HQ drilling is being undertaken in extremely hard ground and "bit weight" pressures below 200 psi (1.4 MPa) are required for adequate penetration rates, the pump compensator should be reset to prevent the "bit weight" pressure gauge falling below 200 psi (1.4 MPa).

The use of softer matrix bits should be considered before adjusting the secondary pump pressure compensator.

If it is necessary to reset the secondary pump compensator, this should only be increased to a maximum of 2000 psi (13.8 MPa) on the feed pressure gauge.

When drilling deep holes and operating the feed in a hold back situation (ie. keeping the rods in tension by not allowing the full weight of the drill string on to the diamond bit), the secondary pump compensator setting should be readjusted to 1000 psi (6.9 MPa). This will increase the sensitivity of the fine feed flow control valve.

The secondary pump compensator should never be adjusted below 1000 psi (6.9 MPa) as this may be insufficient pressure to open the chuck which also operates off this circuit.

Feed Pressure Reducing Control Valve

Situated below the Fine Feed Flow Control valve and accessible from the front of the Hydraulic Module, is the Feed Pressure Reducing Control Valve. This valve controls the desired sensitivity of the Feed Rate Control (item 22) as required when rod weight contributes to the force on bit.

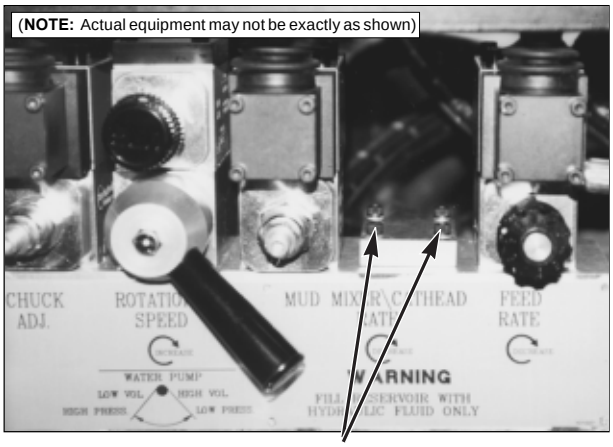
At the start of the hole the Pressure Reducing Valve should be at maximum setting or at maximum feed circuit pressure (2000 psi, 13.8 MPa). As the rod weight contributes to the force on the bit, the Pressure Reducing Valve setting can be decreased to maintain a relatively constant hold back pressure.

When the desired sensitivity of penetration is lost you may adjust the Pressure Reducing Valve in order to regain the desired sensitivity. Generally adjustment may be beneficial starting at approximately 3600 to 4100 lbf (16 014 to 18 238 N) of drill rod weight, but is dependent on many factors.

NOTE: After the hole is completed, always reset the Pressure Reducing Valve to full open.

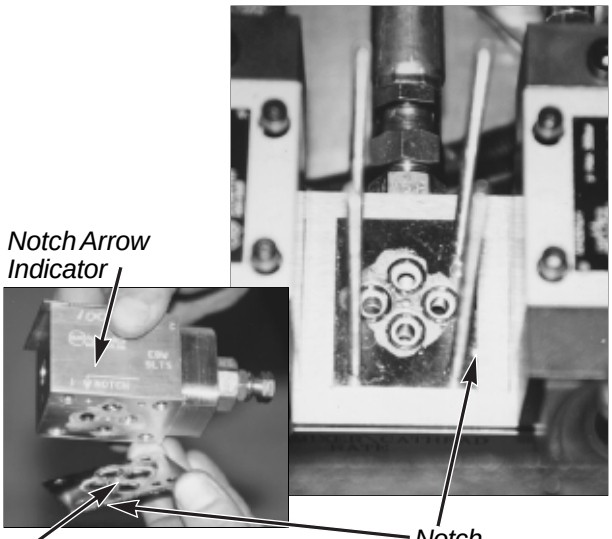
Installation of Mud Mixer Piping Group (if applicable) p/n 101762

1. Ensure that the valve area is clean of all debris and dirt. Remove the four bolts and the cover plate from the existing valve manifold.

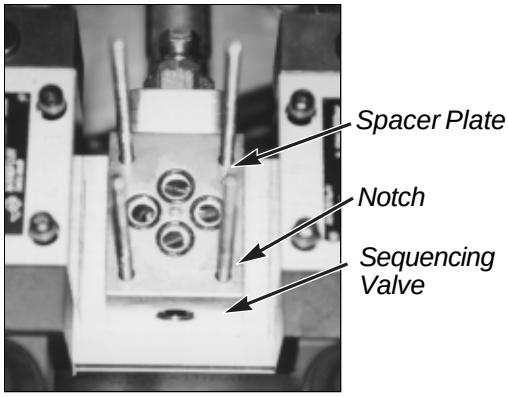


Remove the four nuts

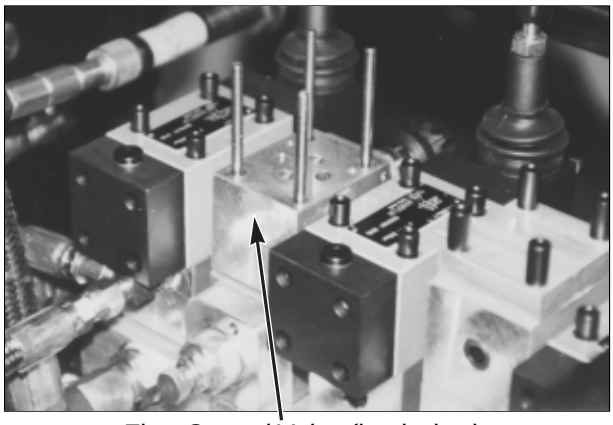
2. Install the four studs and spacer plate complete with the four “O” rings.
3. Ensure that the spacer plate has the dimple facing up. The notch on the plate should be oriented as shown below.



4. Install the sequencing valve and spacer plate with the notch as shown below.

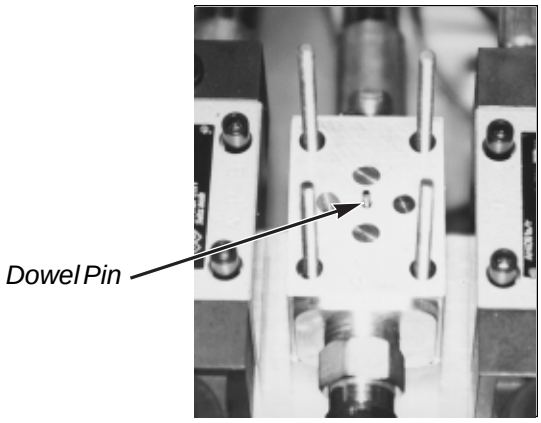


5. Install the flow control valve on top on the sequencing valve.

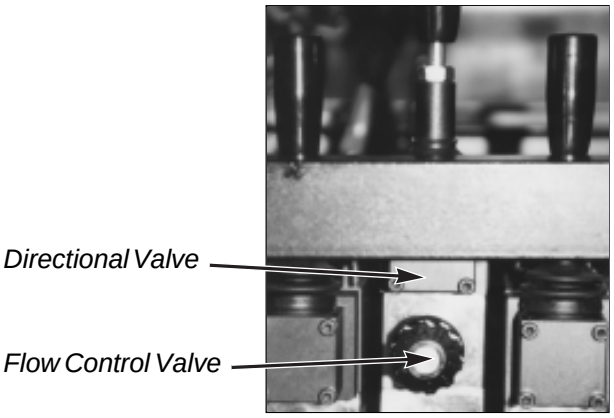


Flow Control Valve (back view)

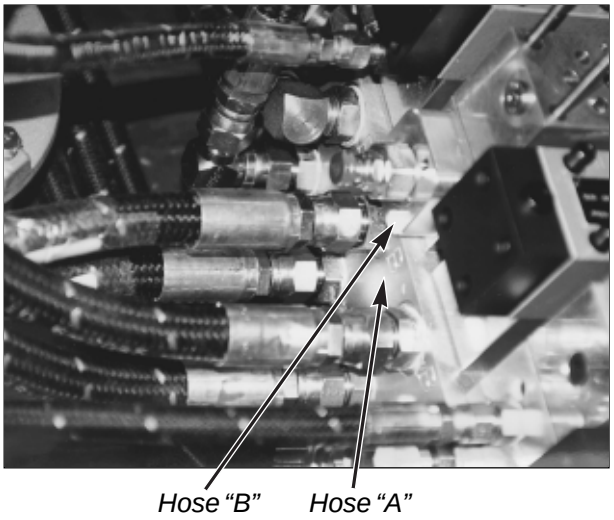
6. The dowel pin must be inserted to the top of the flow control valve. Evenly torque all four stud nuts at 40 - 45 in/lb in a crisscross pattern.



7. Install the directional valve on top of the flow control valve.



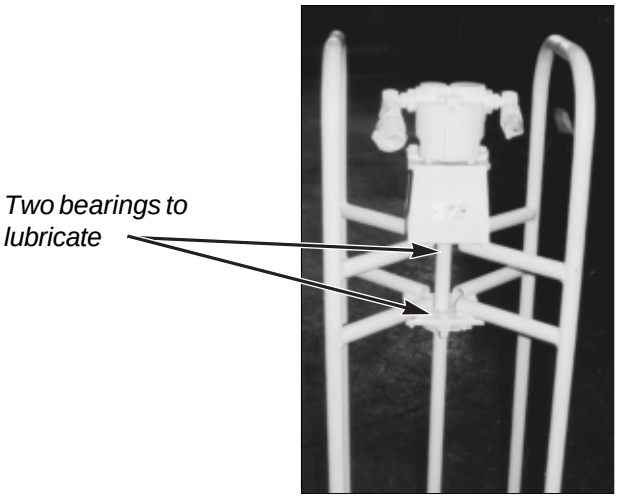
8. Connect the two hoses to the ports as indicated. Attach the other ends of the hoses to the motor of the mud mixer. If the mud mixer operates opposite to what the decal indicates, reverse the two hoses on the back of the valve bank.



NOTE: Piping Group (p/n 101762) includes all fittings, hose, valves, hardware and decals.

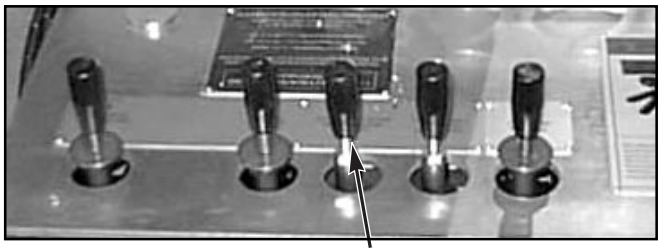
9. Mud Mixer Maintenance

The mud mixer has two bearings which should be lubricated according to the lubrication chart.



Auxiliary (Mud Mixer) Selector Valve

This is a detented, four-way, two position valve which either opens or closes the mud mixer/cathead circuit.



Auxiliary (Mud Mixer) Selector Valve

NOTE: If the Flow Control Valve is not installed as per instructions on page 6-09 (meter out instead of meter in) the shaft seal in the Mud Mixer Hydraulic Motor could be damaged.

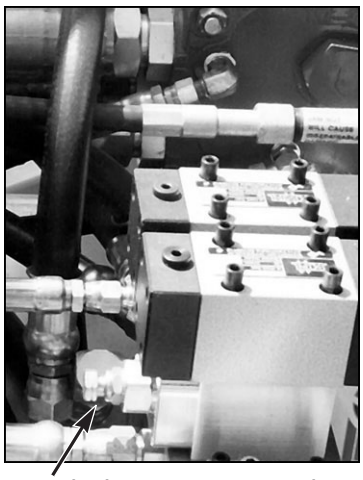
A flow control valve is below this selector valve which controls the mud mixer speed. Clockwise adjustment of the flow control valve will reduce speed while counterclockwise adjustment will increase speed. Comes with a mechanical “lever lockout” device to prevent accidental actuation of selector valve. Lift to shift lever for raising or lowering mast.

A sequence valve is sandwiched below this flow control valve which ensures the fine feed circuit receives priority from the secondary pump.

To set this sequence valve, join the two mud mixer hoses together and place the lever in the “off” position. Adjust the flow control valve to maximum open by rotating the knob counterclockwise. When the auxiliary lever is put in the “on” position, the indicated pressure on the feed pressure gauge should drop 100 psi (0.7 MPa). That is, if the fine feed circuit has been adjusted to 2000 psi (13.8 MPa), this should drop to 1900 psi (13 MPa) when the mud mixer/cathead circuit is switched “on”.

To maintain priority in the fine feed circuit, the sequence valve meters flow to maintain pressure in the feed circuit before it will allow flow to the mud mixer circuit.

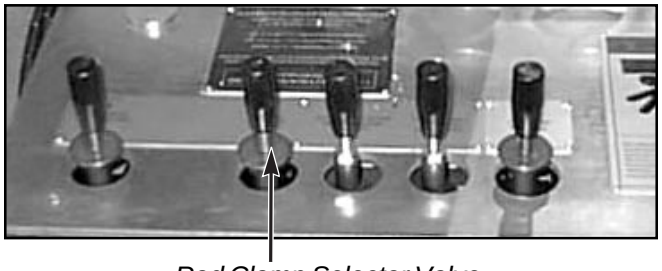
NOTE: This is the only flow control metering device used in the LF70 hydraulic system. Because of the low flows involved, efficiency of the system is not impacted to any degree by the use of such a valve.



Mud Mixer Sequence Valve Adjusting Screw

Rod Clamp Selector Valve

- This two-position, detented selector valve will “open or close” the foot clamp. Moving the lever forward closes the clamp, pulling the lever back towards the operator opens the chuck. Comes with a mechanical “lever lockout” device to prevent accidental actuation of selector valve. Lift to shift lever to open/close the foot clamp.



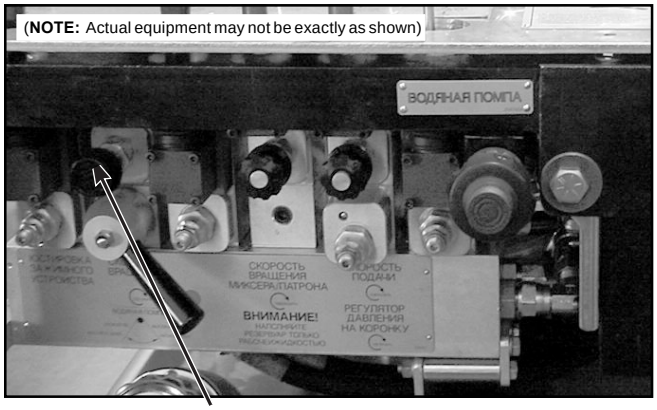
Rod Clamp Selector Valve

Rotation Speed Control

- The fourth section (when viewed from the operator's stand) of the secondary circuit manifold is dedicated for the rpm control of the rotation motor.

A pilot pressure from the rotary control, strokes the lens of the hydraulic motor swash plate. Hunting isn’t a problem as the pilot pressure we are using, is taken from the secondary circuit. If we were sourcing the pilot pressure from the primary circuit, then surging would be induced through down hole torques.

This control has an orifice which keeps the secondary pump compensated and reduces flow to the rotation motor control. This valve is adjustable from 25 - 400 psi (0.2 -2.8 MPa) while the hydraulic rotation motor control is set from 50 - 200 psi (0.3 - 1.4 MPa).



Rotation Speed Control

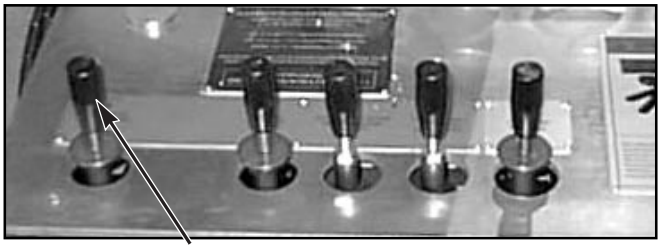
At pressures above 400 psi (2.8 MPa), this valve will vent to tank. As the flow involved is only 0.5 gpm (2 L/min), heat generation is minimal.

Chuck Mode Selector Valve

- This is the final section on the secondary circuit manifold and controls the opening and closing of the hydraulic Auto Chuck. A four-way, two position, detented valve, controls the oil flow direction for this function. Comes with a

mechanical “lever lockout” device to prevent accidental actuation of selector valve. Lift to shift lever to open/close the chuck.

NOTE: Before making any adjustment to this (PRD/PRV) valve, check mechanical condition of chuck i.e. clean and grease sliding surfaces between chuck jaws and surrounding parts.



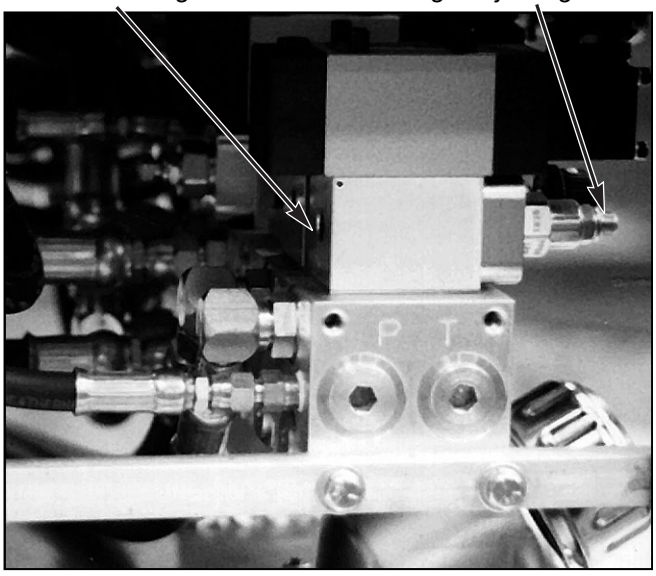
Chuck Mode Selector Valve

Sandwiched below this valve is a pressure reducing valve (PRD) and pressure relief valve (PRV).

If adjustment is necessary, proceed as follows:

Install a pressure gauge (0 - 1000 psi, 0 - 6900 kPa) in place of the 1/4" NPTF plug located on the back side (opposite cartridge adjusting screw) of (PRD/PRV) valve.

1/4" NPTF Plug *Cartridge Adjusting Screw*



PRD/PRV Valve

With the selector shifted to open the hydraulic chuck, turn the cartridge adjusting screw in clockwise to increase pressure setting **JUST** to the point where the hydraulic chuck will fully open **(not beyond this point)** and tighten locknut. For Auto Chuck, the adjustment ranges from 650 to 850 psi (4500 to 5900 kPa).

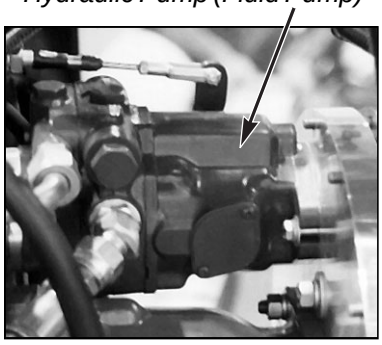
Replace gauge plug on back side of (PRD/PRV) valve.

Once set, this should not be altered during normal operation.

Auxiliary Circuit

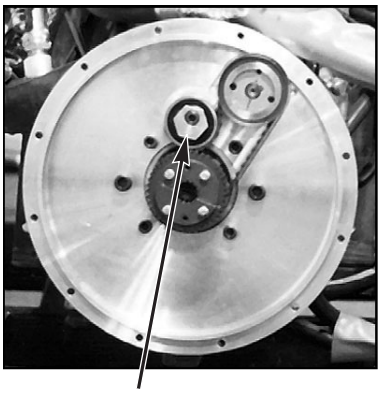
- This circuit powers the hydraulic driven fluid pump and is a fully hydrostatic drive (ie. it is a totally closed loop system). The pump for this circuit is an axial piston design with a manual swash plate control.

Hydraulic Pump (Fluid Pump)



Pump Adaptor Flange

The pump is mounted to the aluminum pump adapter flange which is bolted to the diesel engine bell housing. Drive for this pump is via a toothed timing belt which is powered from a gear located behind the toothed adapter on the drive shaft of the primary pump. An adjustable tensioner keeps this timing belt correctly loaded. The suction inlet for the auxiliary pump features a 100 mesh strainer located inside the aluminum hydraulic reservoir (with 3 psi - 20 kPa vacuum bypass valve) and an external gate valve to isolate the reservoir, should the system require maintenance. This auxiliary pump has a small internal charge pump located inside the main case to make up any losses in the system. The charge pump has an internal relief valve.



Adjustable Tensioner

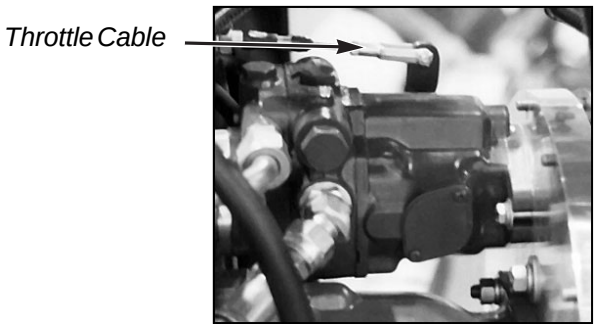
⚠ WARNING Demand or shock loading on the timing belt can be avoided by ensuring that the Swash Plate Contol is shifted to minimum flow before shifting the two speed motor control or shutting down the drill.

Output from the auxiliary pump is directed to a two-speed pilot shift motor which powers the fluid pump. Return oil from the hydraulic motor is directed back into the inlet of the auxiliary pump, hence the totally closed loop system. Because of this design, the internal charge pump is essential to make up for losses from the case drain, etc.

This pump has a relief valve cartridge set at 2000 psi (13.8 MPa) to prevent the fluid pump motor from being over pressurized as well as limiting the demand on the timing belt driving the pump.

Output of the auxiliary pump is determined by manually altering the swash plate angle of the unit by a throttle cable. Because the fluid pump only

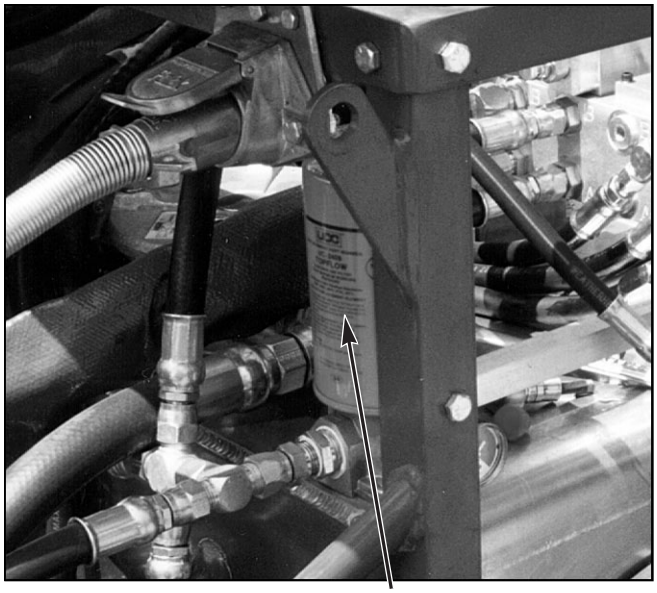
requires propulsion in one direction, the relief valve cartridge is removed from the opposite port. By doing this, if the swash plate is returned over centre, the pump will not begin to rotate in the opposite direction.



(**NOTE:** actual equipment may not be exactly as shown)

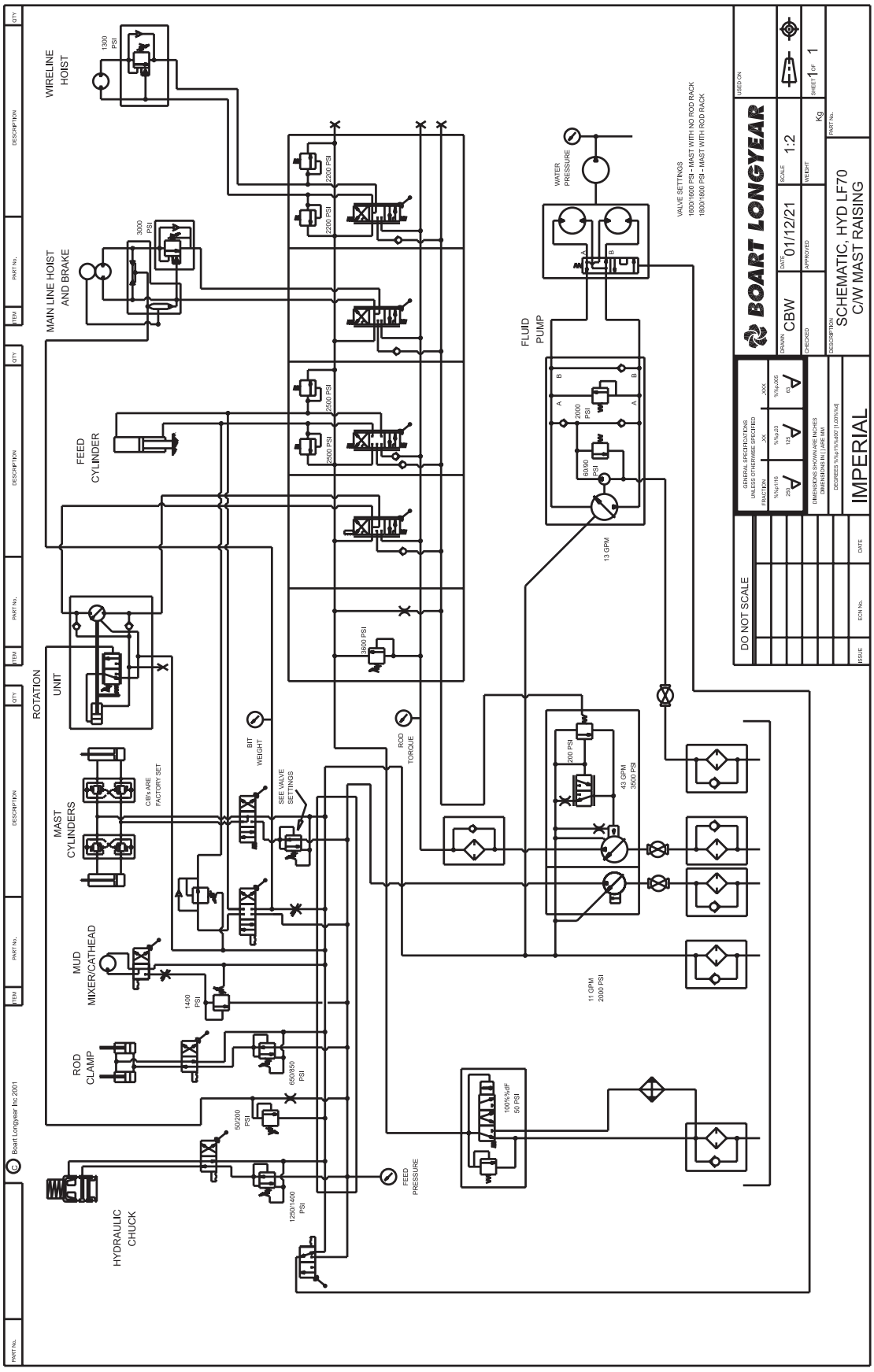
Case Drain Return Circuit

- All hydraulic pumps and motors with external case drains have these plumbed together with the secondary circuit return oil into the case drain filter. This is a spin on cartridge which will remove any contamination prior to oil entering the hydraulic reservoir.



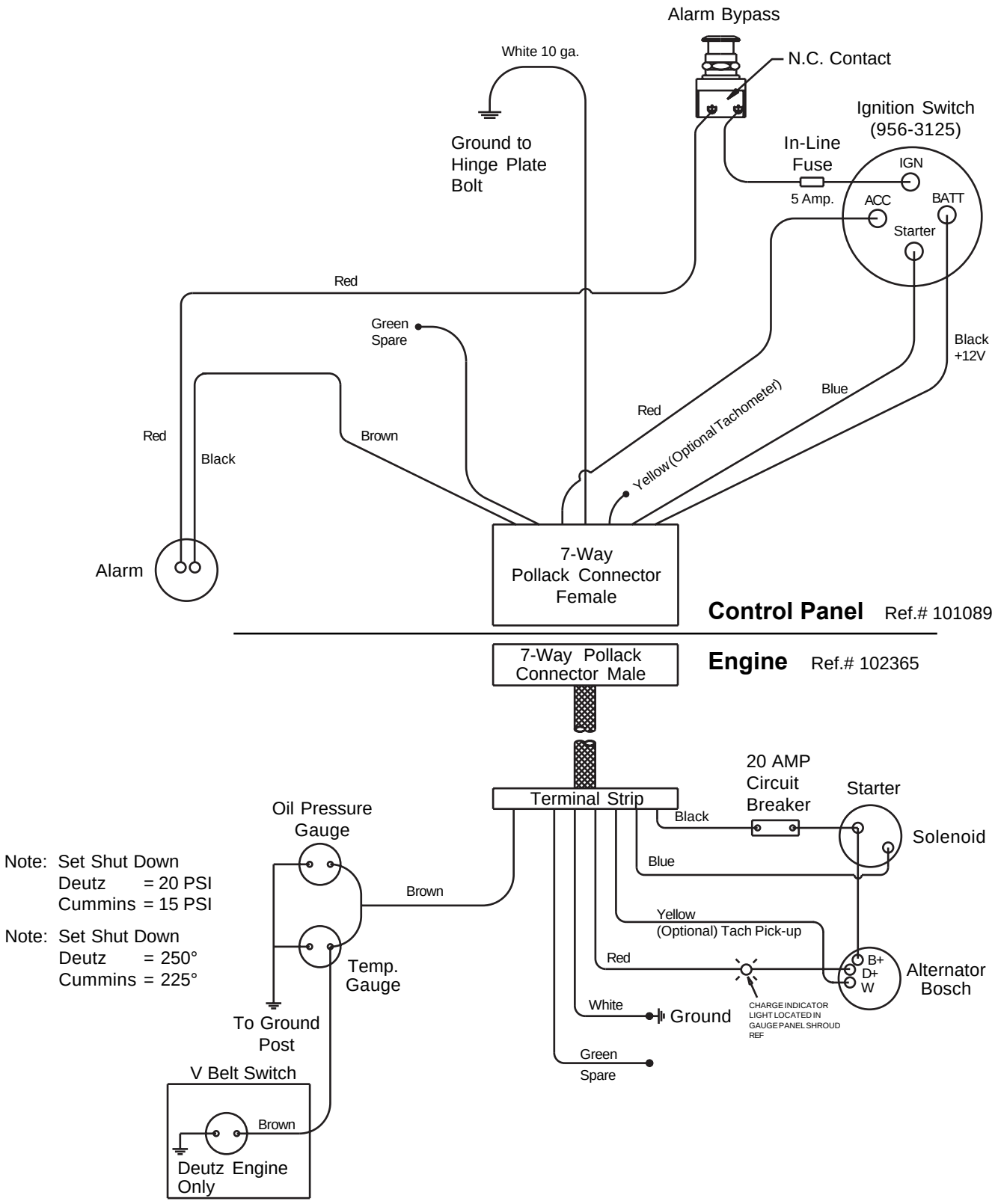
Case Drain Oil Filter

Hydraulic Schematic



6-2 Electrical Schematic

Electrical Schematic



General Maintenance and Trouble Shooting

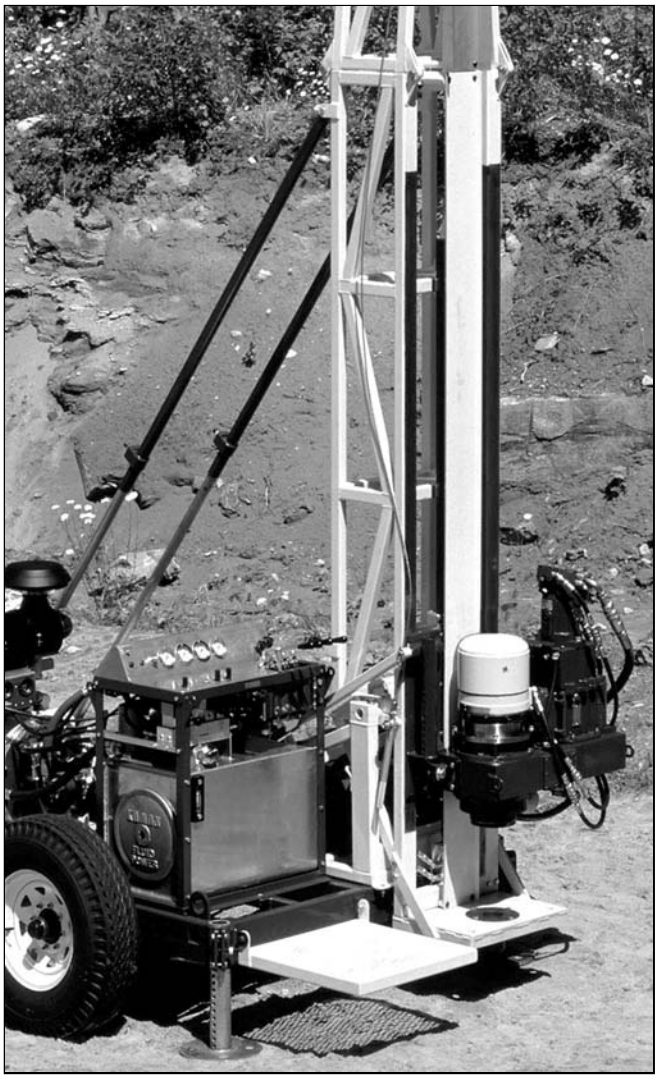
Drive Head Chain Field Maintenance Check and Adjusting Procedures

The proper tension of the drive head chain is of utmost importance.

The first tension inspection should be carried out after approximately 500 hours of operation.

Following the above break-in procedures for the drive head chain, a regular tension inspection should be carried out after approximately every 1000 hours of operation.

1. Raise the mast assembly to the vertical position, observing proper safety procedures to stabilize the unit.

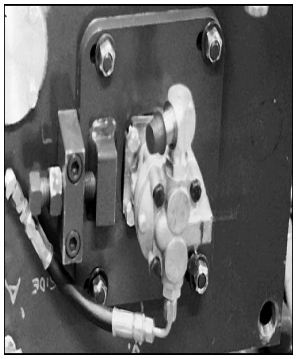


(**NOTE:** Actual equipment may not be exactly as shown)

Item 1

2. Move the drive head assembly to a position of easy access for maintenance and secure safely.

3. To adjust the drive head chain tension, first drain the head box of hydraulic oil. Remove the square head pipe plug (drain plug) from the base of the unit. Capture the escaping oil in a suitable container so that it may be properly disposed of. **DO NOT reuse this oil.**

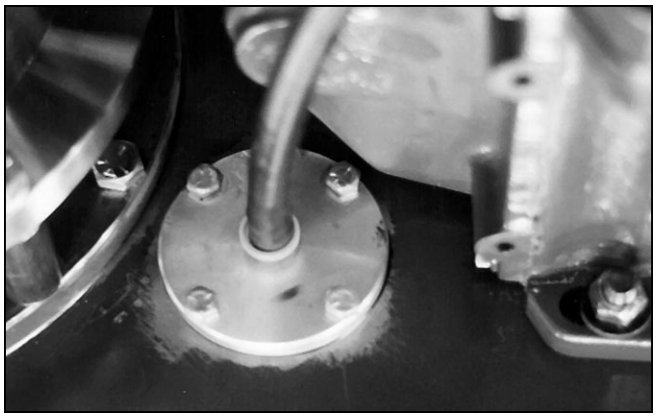


⚠ WARNING **Damage can result if above procedure is not followed.**

4. Loosen the two lock nuts on the upper head hinge support (see 7-11: Rotation Unit Group Reassembly) on the upper left side of the Funk transmission. This will allow for free movement of the Funk transmission during adjustment.

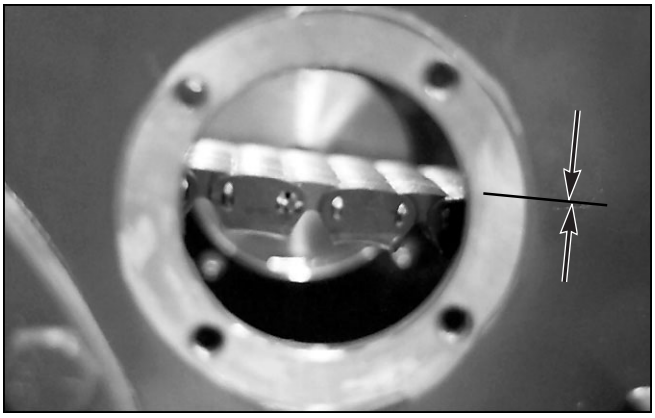
Item 4

5. Remove the four capscrews which secure the top chain link service cover and remove cover. (Leave breather hose attached.)



Item 5

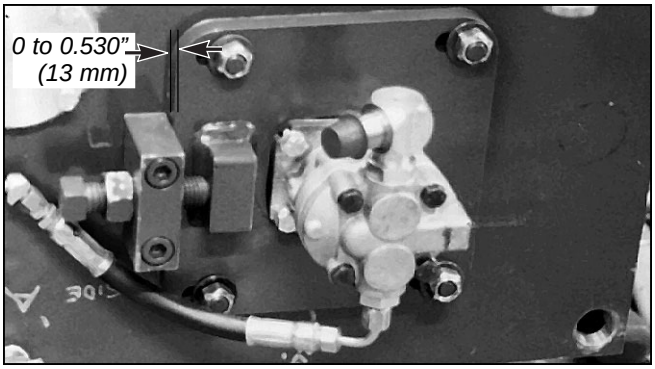
6. Check the drive head chain tension through the top chain link service port using a ruler. The amount of play in the chain at the service port should be 1/2" to 3/4" (1 to 2 cm) up and down (total). This should be undertaken using hands only and **not** prying with a screwdriver or levers.



Item 6

If necessary, adjust the drive head chain tension with the adjusting set screw on the final drive pinion carrier plate as follows:

a) Loosen the four 1/2" all steel locknuts on the final drive pinion carrier plate.



Items 6a and 12

b) Loosen the four 1/2" all steel locknuts which secure the Funk transmission.

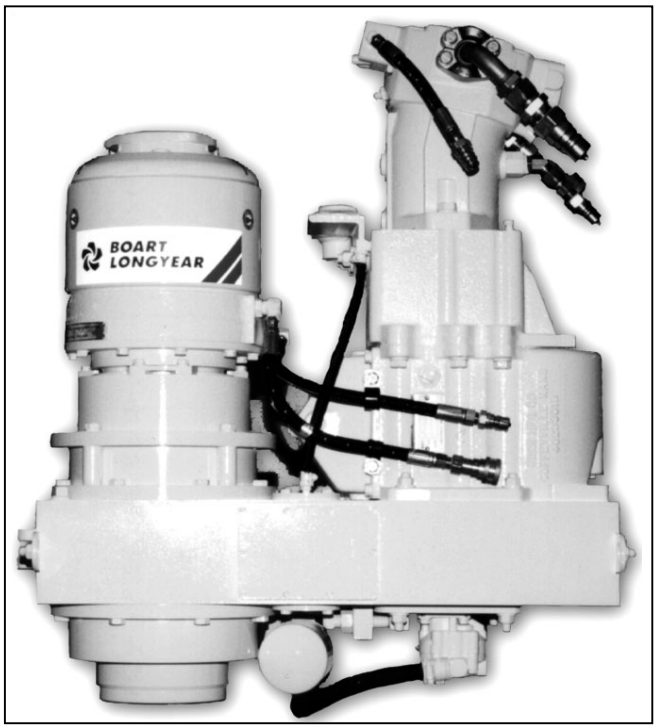
c) Adjust the drive head chain to the correct tension using the adjusting set screw on the adjuster block against the final drive pinion carrier plate. Once achieved, lock the adjusting set screw in position with the hex locknut. *(See photo Item - 6a and 12)*

d) Tighten the four final drive pinion carrier plate all steel locknuts prior to tightening the four Funk box all steel locknuts.

e) Once the four Funk box all steel locknuts are snug, loosen the four final drive pinion carrier plate all steel locknuts, then, retighten them to 90 ft lb (122 Nm).

f) Ensure the correct drive head chain tension has been maintained, then, loosen and retighten the four Funk box all steel locknuts to 90 ft lb (122 Nm).

7. Once the drive head chain has been correctly tensioned, check that the drill head hinge pin (bottom centre of head box) aligns in its two respective bores (on upper hinge support and lower hinge plate). If the chain adjustment has affected the hinge pin alignment, reposition the flat washers behind the upper head hinge support (on the upper left side of the Funk transmission) to regain correct alignment.



Item 7

8. Clean the top, chain link service cover and appropriate four capscrews. Apply new RTV silicon sealant to the bottom cover and the four 5/16" x 3/4" UNC capscrews to prevent leakage from the head box. Now, fasten the cover to the head box.

9. Reinstall the square head pipe plug (drain plug) in the base of the head box.

NOTE: Be sure the head is exactly level and vertical when filling with oil.

10. Refill the head box with the correct amount of **NEW** hydraulic oil through the top chain link service port. Refer to page 9-05 for a list of lubricants.

11. Clean off any old sealant from the top chain link service cover and the four 5/16" X 3/4" UNC capscrews used for fastening. Now, apply new RTV silicon sealant to the top cover and capscrews to prevent leakage from the head box. Secure the top chain link service cover to the head box with the four capscrews.

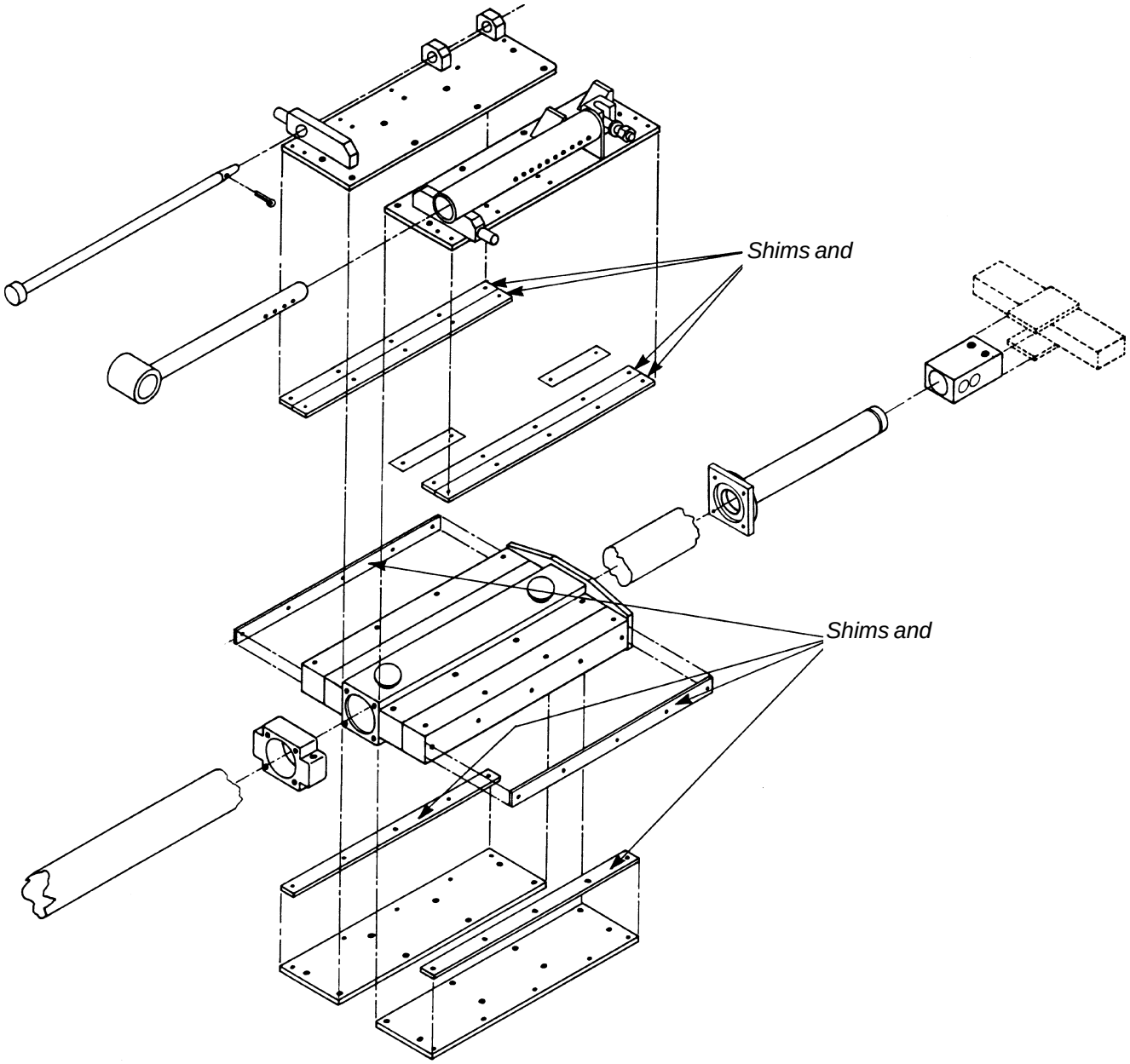
12. When chain is initially installed into drive head, the final drive pinion carrier plate should be in contact with adjuster block. When the distance between adjuster block and pinion carrier plate reaches 0.530 in (13 mm) the drive chain is at the maximum allowable wear and **must be replaced**. This distance coincides with full adjustment available from the (4) slotted holes in the pinion carrier plate.
(See photo Item - 6a and 12)

Head Slide Wear Bars Field Maintenance Check and Adjustment

As the head slide wear bars wear down, the head movement will increase to a point that replacement shims (p/n 100172) 0.015" and 0.018" (0.38 mm and 0.45 mm) should be used to correct head movement.

Depending on the wear pattern or location, the shims can be used as is (full length) or cut into shorter sections in order to fill gaps that may occur between wear bars and lower mast slide surfaces.

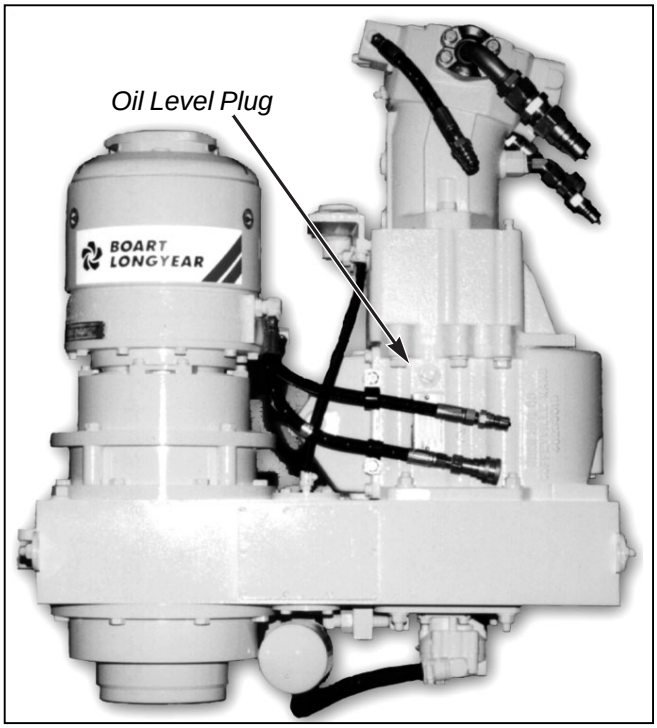
This will maintain head positioning and extend the service life of the wear bars.

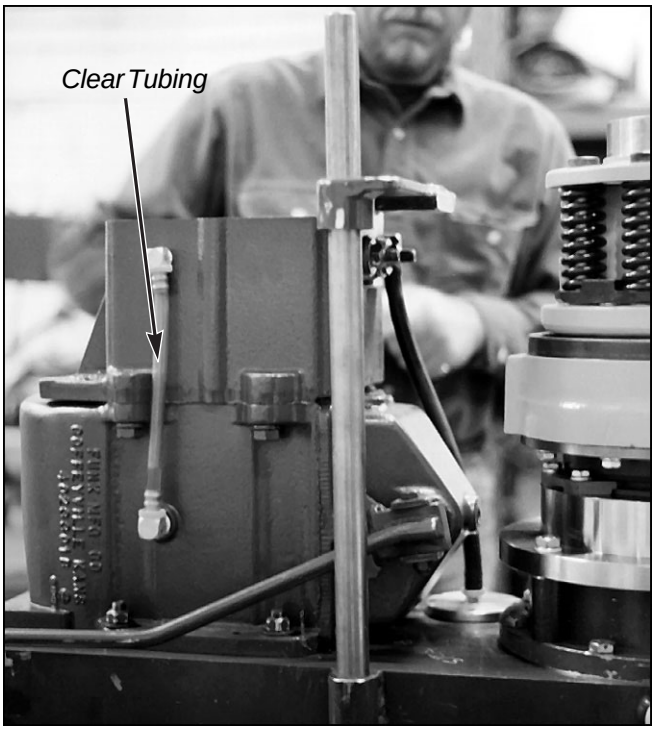


NOTE: Ensure head is exactly level and vertical when checking oil level.

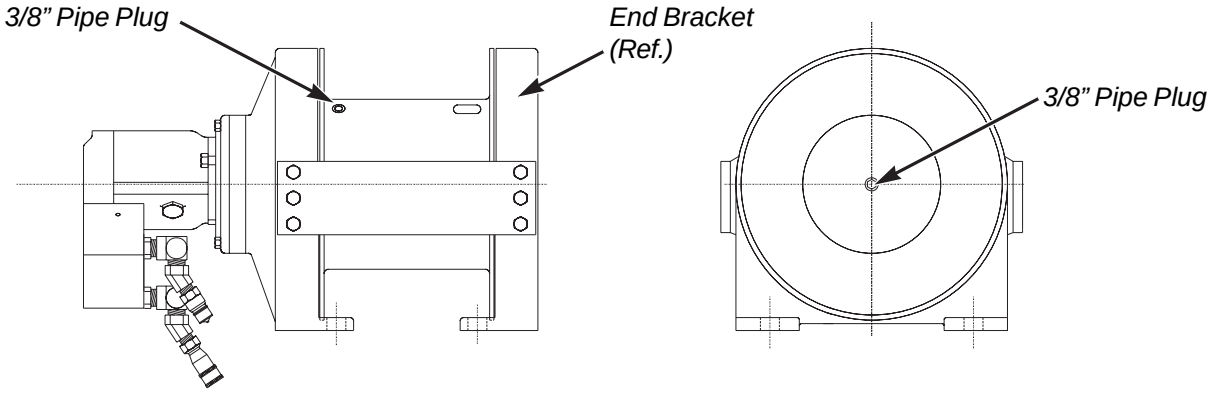
CAUTION **Do not overfill. To do so will result in overheating.**

Refill the Funk transmission assembly to the correct level with engine oil (original factory fill quantity is 8 quarts U.S. or 7.5 L). Refer to page 9-05 for a list of lubricants. With head assembly in the vertical position and no spindle rotation, the maximum or full level will be when oil reaches the oil level plug located on front face of transmission. This oil level can also be monitored through the clear tubing on the back side of the head assembly.





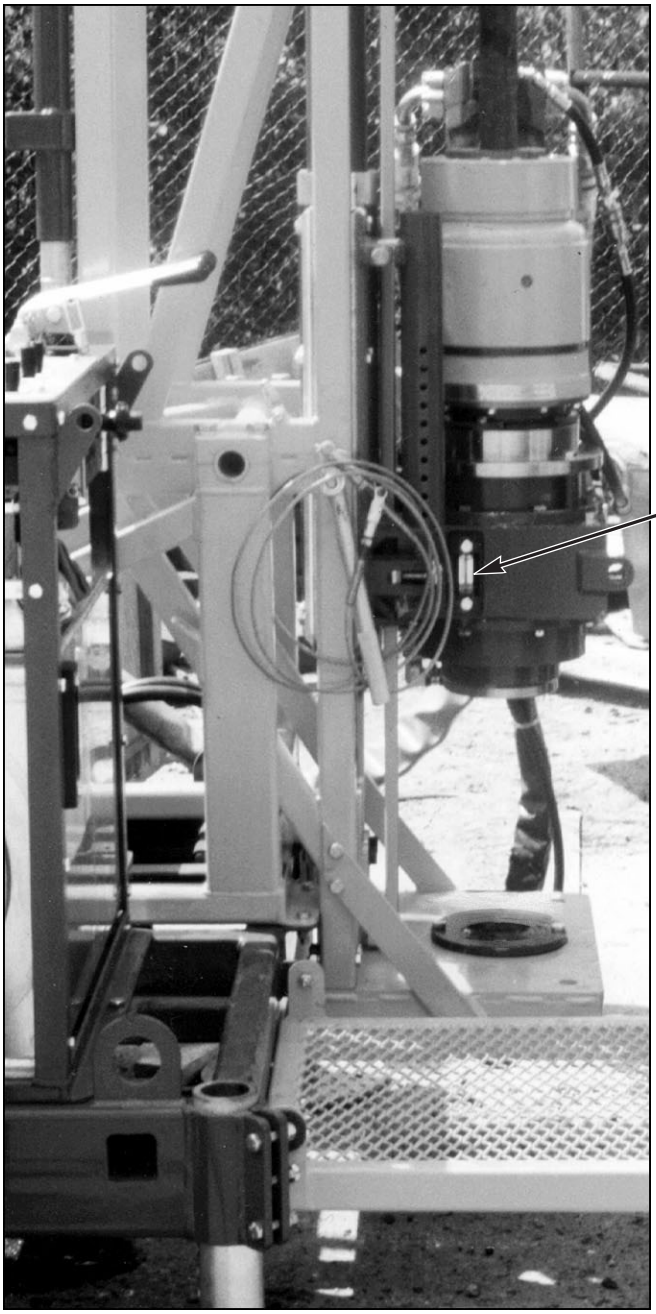
Refill the Main Line Hoist (KPL 12) to the correct level with gear oil (original factory fill quantity is 2 quarts U.S. (1.9 L)). Refer to page 7-11 for a list of lubricants. Filling is done by removing the 3/8" pipe plug on the drum or at the centre of end bracket. The maximum or full level will be when the oil reaches the oil level plug located on the centre of the end bracket.



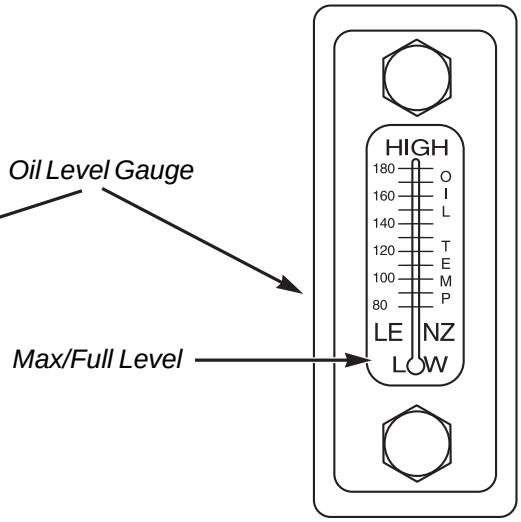
NOTE: Ensure head is exactly level and vertical when verifying oil levels.

CAUTION **Do not overfill. To do so will result in overheating.**

Refill head box to the correct level with hydraulic oil (total 7 quarts U.S. 6.6 L). Refer to page 7-11 for a list of lubricants. With head assembly in the vertical position and no spindle rotation, the maximum or full level will be at the **lower** end of the 3" oil level gauge located on operator's side of the head box.



(**NOTE:** Actual equipment may not be exactly as shown)



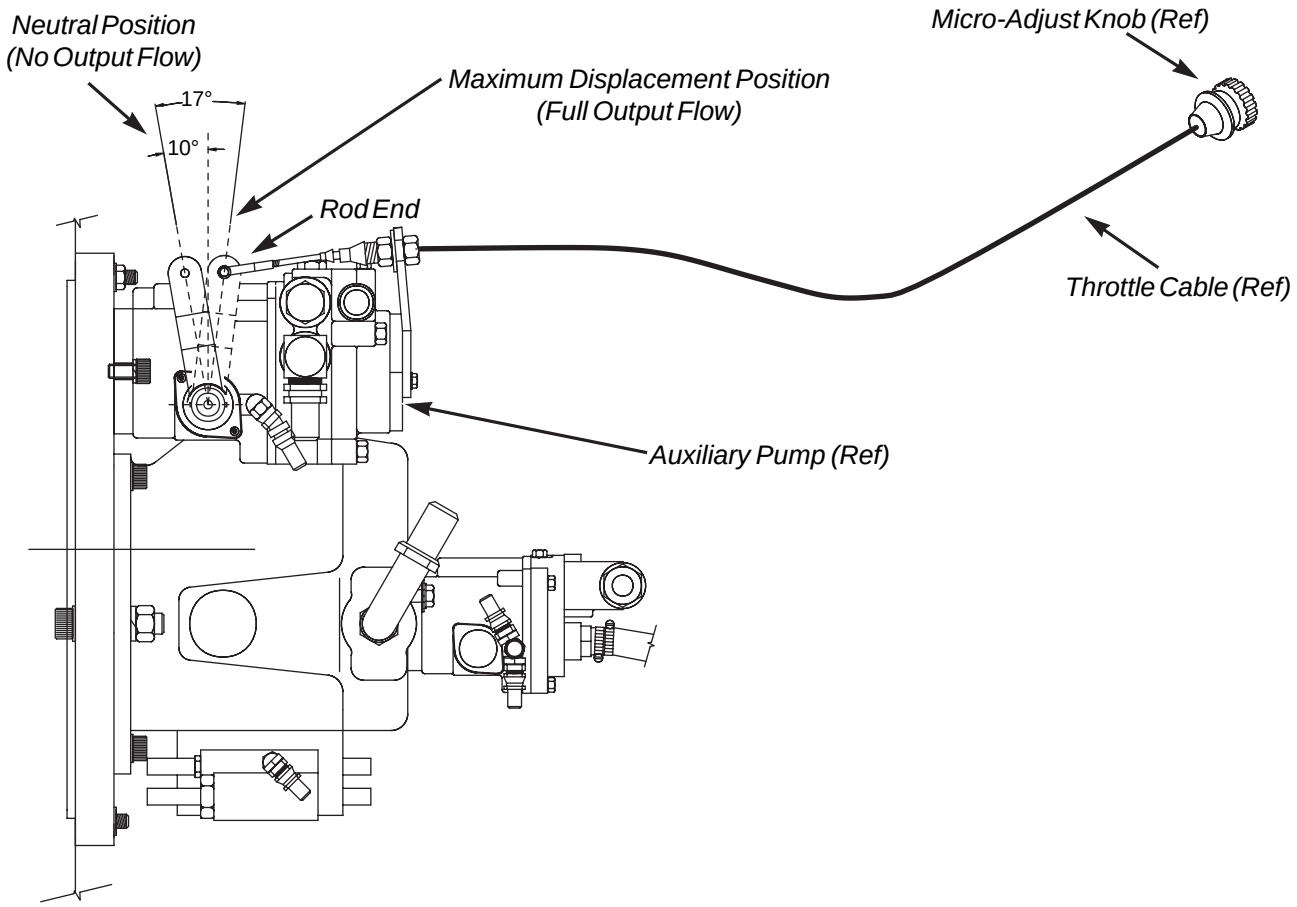
Temperature gauge is measured in degrees Fahrenheit (°F).

Conversion to degrees Celsius (°C):
(°F) x 0.556 = (°C)

Auxiliary Pump Output - Field Maintenance Check and Adjustment

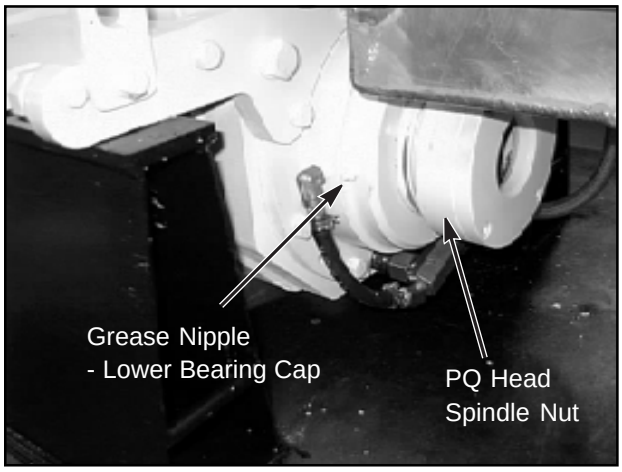
Output of the Auxiliary pump is determined by manually altering the Swash Plate angle of the unit by a throttle cable. This is installed and adjusted at the factory. For field adjustment refer to drawing below.

Adjust so that the bolt going through the rod end lines up with the hole in lever when lever is rotated fully clockwise and cable is fully retracted (except for 1/2 turn clockwise on micro-adjust knob).

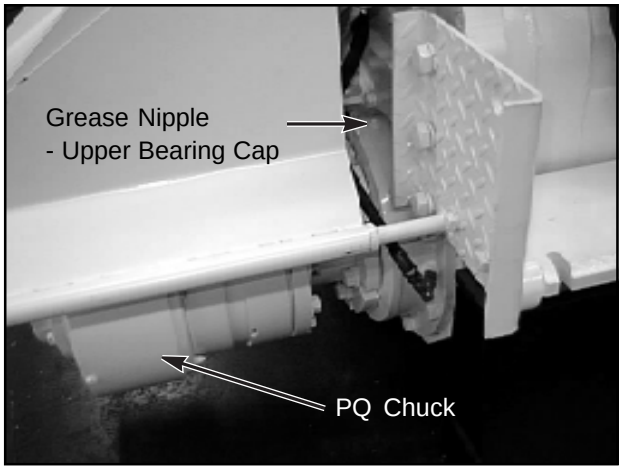


PQ Head Bearing Lubrication

The grease fittings on upper and lower bearing caps should have three (3) shots of multipurpose grease from a hand operated grease gun every 8 hours while rotating slowly.



Actual equipment may not be exactly as shown.



Actual equipment may not be exactly as shown.

PQ Head Box Oil Level

⚠ WARNING Do not overfill. To do so can result in overheating.

Ensure the PQ head is to the correct level with hydraulic oil (original factory fill quantity is approx. 10.5 quarts (10 litres)). The drill must be level in all directions with head assembly in the vertical position when determining the proper full level.

Schedule: Change Interval 250 hrs

Item	Description	Location	Number of Lube Points	Lubricant Type	Lube Method	Quantity (U.S.)	Quantity (Metric)	Change Interval (hrs)	Level Check Interval (hrs)
1	Power Unit	See Manufacturer's Operation and Service Manual							8
2	Transmission 4 Speed	Rotation Unit Group	1	ENGINE OIL	Change	† 8 Quarts	7.5 Litres	250	8
3	Drive Head Assembly	Rotation Unit Group	1	Hyd Oil	Change	† 7 Quarts	6.6 Litres	250	8
4	Hydraulic Reservoir	Hydraulic Module	1	Hyd Oil	Change	† 38 Gals	144 Litres	as req'd	8
5	Flange Bearing	Wireline Hoist	1	MPG	Grease Gun	2-3 Shots		60	168
6	Main Line Hoist	Draw Works Group	1	Gear Oil	Change	† 2 Quarts	1.9 Litres	250	168
7	Sheave Block Ass'y	Lower Mast Next to Rod Guide Actuating Lever	1	MPG	Grease Gun	2-3 Shots		8	168
8	Lower Mast/Draw Works Pivot	Near Control Panel	2	MPG	Brush/Hand	Coat Shaft		Upon Assembly	168
	Options								
9	Water Pump*	See Pump Manufacturers Specifications							
10	Mud Mixer*	Separate	2	MPG	Grease Gun	2-3 Shots		60	168
11	Rod Clamp*	Base of Drill	2	MPG	Grease Gun	2-3 Shots		60	168
12	Auto Chuck*	Head	See Automatic Chuck Service Manual						

Lubricant Code

Season		Winter	Summer	Hot Climate
Start Up Temp Low (Celsius)**		-26°	-22°	0°
Operating Temp High (Celsius)		20°	25°	31°
Engine Oil	- SAE Grade	See Engine Manufacturer's Specifications		
Hydraulic Oil	- ISO Grade***	32	46	68
	- Imperial Oil	Nuto H32	Nuto H46	Nuto H68
	- Shell	Tellus T32	Tellus T46	Tellus T68
	- Chevron	AW MV 32	ISO VG 46	ISO VG 68
	- Mobil	DTE13M	DTE15M	DTE16M
Not Affected by Temp				
Gear Oil	- SAE Grade	80W90		
	- Imperial Oil	GX-80W90		
	- Shell	Spirax 80W-90		
	- Chevron	Delo 80W-90		
	- Mobil	Mobilube HD 80W90		
MPG - Multipurpose Grease				
	- Imperial Oil	Unirex EP 2		
	- Shell	Darina XL EP 2		
	- Chevron	Ulti-Plex EP2		
	- Mobil	Mobilux EP2 Mobilith AW 2		

* Not Shown

**Note: Upon cold start up allow engine to run at low idle until the hydraulic tank is warm to touch before operating at high idle otherwise damage to the Hydraulic system and/or Power unit may occur .

Note: Colder Start Up - preheat engine and hydraulic oil in a safe manner (No Open Flames)

***Note: Do not mix brands of oil, flush completely before changing. Hydraulic system is filled with Shell Tellus H46 from the factory.

† **Liquid volumes are original factory fill quantities only, they are not refill quantities. Refer to Operations and Service Manual for proper procedure to check oil levels.**

All volumes are in US measure or litres.

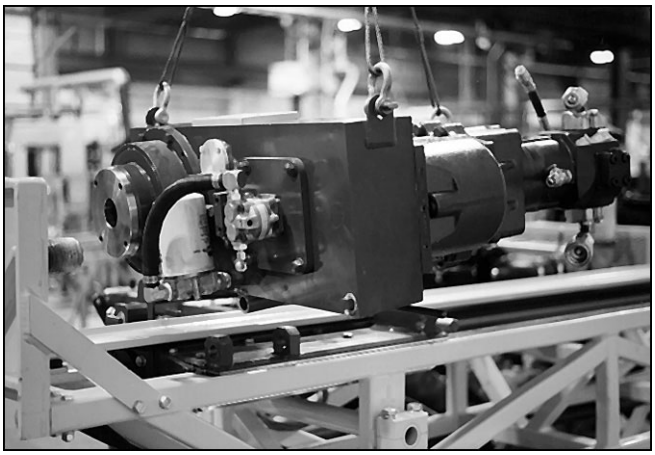
Filter Reference Chart

Item	Filter Description	Filtration Part Number	Filter Element	Qty	Service Remarks
1	Main Pump Pressure	10 Micron Bypass Valve	100188	1	Change element when visual indicator displays to do so or @ Hydraulic oil change
2	Main Return Filter	10 Micron Bypass Valve	100236	1	Change element when visual indicator displays to do so or @ Hydraulic oil change
3	Case Drain Filter	25 Micron Spin On	100237	1	Change element when visual indicator displays to do so or @ Hydraulic oil change
4	Drill Head Lube Filter	25 Micron Spin On	100190	1	Change element @ 250 hour intervals or whenever Drive Head hydraulic oil is changed
5	PQ Drill Head Lube Filter	25 Micron Spin On	3542297	1	Change element @ 250 hour intervals or whenever Drive Head hydraulic oil is changed

Lubrication Chart
LF 70 Drill Assembly
101464
Issue No. 2
Sheet 1 of 1
BOART LONGYEAR

HQ Rotation Unit Group Drill Head Disassembly

1. With suitable lifting equipment, remove the rotation unit group from the carriage using the three lifting points provided.

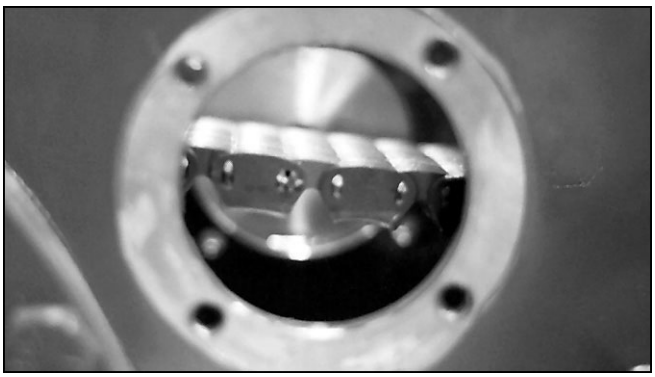


Item 1

2. Place the rotation unit group on a suitable work bench and remove the square head pipe plug (drain plug) from the base of the unit. Capture the escaping oil in a suitable container so this can be properly disposed of (do not reuse this oil).
3. Remove the front service plate located on the front of the head box.

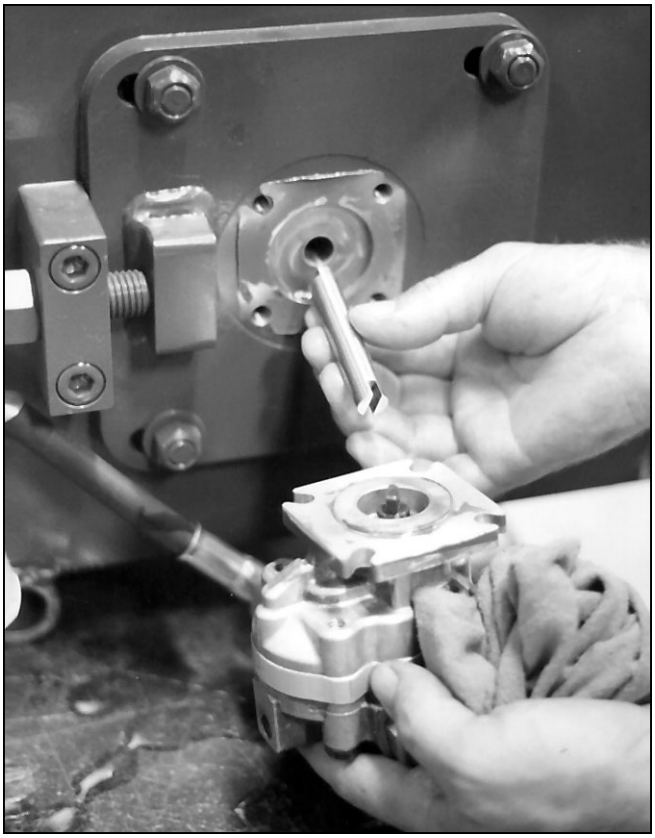
Item 3

4. Rotate the spindle until the master link of the drive head chain aligns with the upper and lower chain link service covers of the head box.

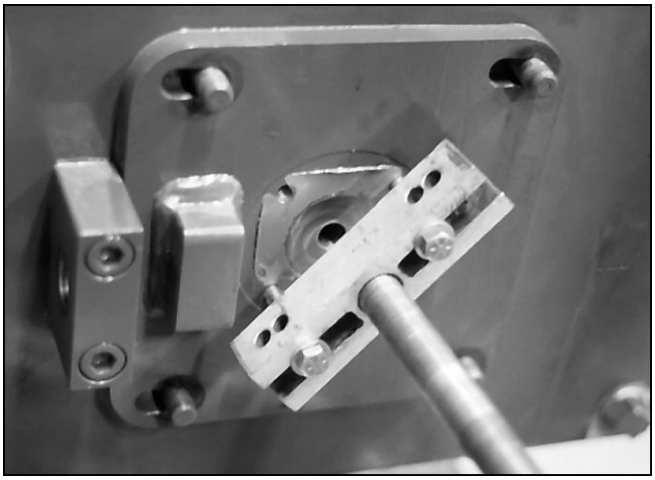


Item 4

5. Remove the four bolts which secure the lower chain link service cover and remove cover.
6. Remove the four bolts which secure the upper chain link service cover and remove cover. (Leave breather hose attached.)
7. Feed a piece of clean cloth through both chain link service openings and underneath the drive head chain. (This is to catch the roll pins or chain master link, should they be inadvertently dropped.)
8. Remove the roll pin from the drive head chain master link with suitable pliers.
9. Withdraw the drive head chain master link through the top chain link service opening. (A small pin punch may be required to assist the removal of the master link.)
10. Thread a piece of thin wire through the end of the drive head chain. Hold tension on the wire and withdraw the blank end of the chain by rotating the spindle by hand (ensure you have enough wire to accomplish this). Maintaining tension on the wire stops the chain from bunching up and jamming internally in the head box.
11. Remove the oil pump suction hose and pressure hose located on the bottom of the head box.
12. Remove the four bolts and lock washers securing the hydraulic gear pump and remove the pump and oil pump drive shaft.



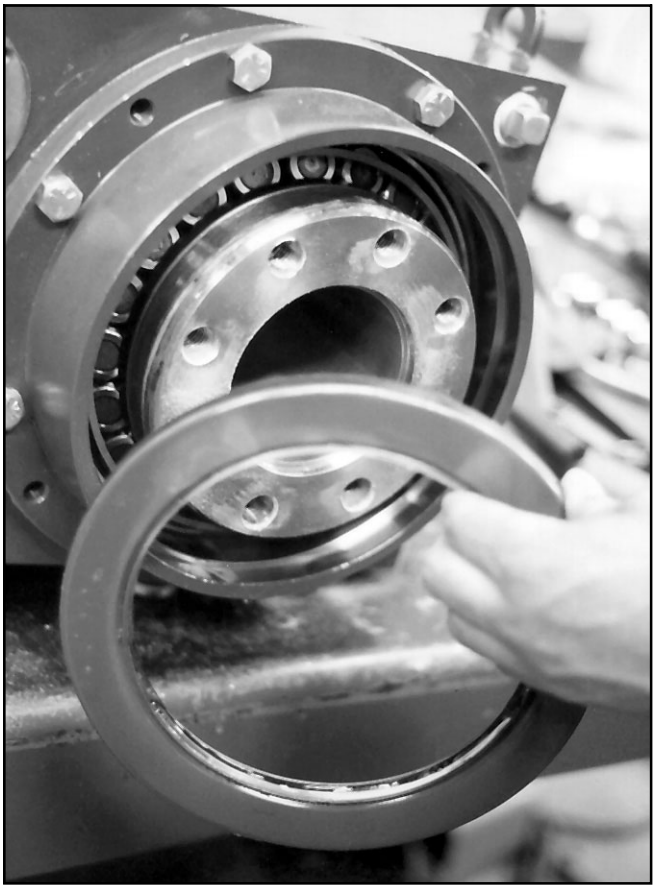
13. Remove the hydraulic oil suction filter with a strap wrench.
14. Remove the hydraulic oil suction filter housing from the base of the head box.
15. Back off the drive head chain tensioning hex lock nut and adjusting square head set screw.
16. Remove the four locknuts securing the final drive pinion carrier plate.
17. Attach a combination bearing puller/slide hammer to the hydraulic gear pump mounting holes and remove the final drive pinion carrier plate by the action of the slide hammer.



Item 17

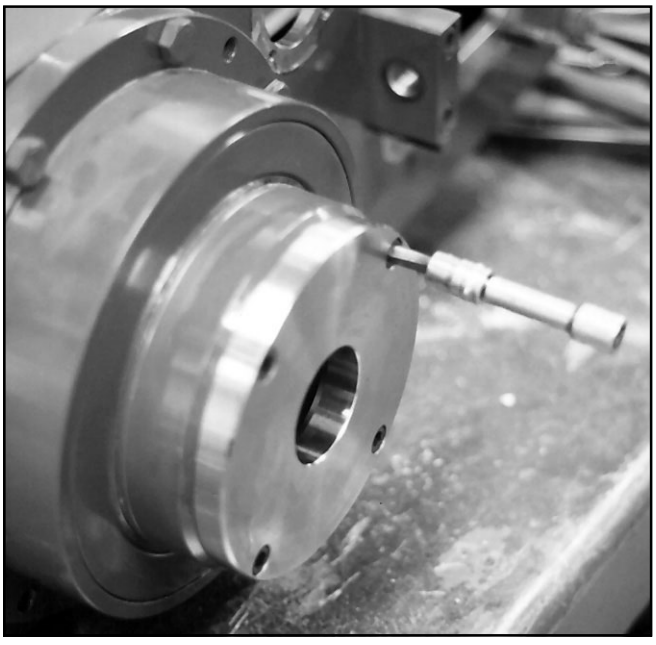
18. Stand the rotation unit group in the upright position (ie. with the chuck in the vertical plane).
19. Remove the two bolts attaching the rotation motor flange to the adapter box and remove the rotation motor by withdrawing it upwards.
20. Remove the rotation motor adapter shaft.
21. Remove the four all steel locknuts securing the 4-speed Funk transmission to the head box.
22. Remove the 4-speed transmission and adapter shaft housing by raising these clear of the head box.
23. Lay the drive head assembly in the horizontal position, with the front service opening facing up.

24. Remove the top spindle bearing oil seal with a screwdriver.



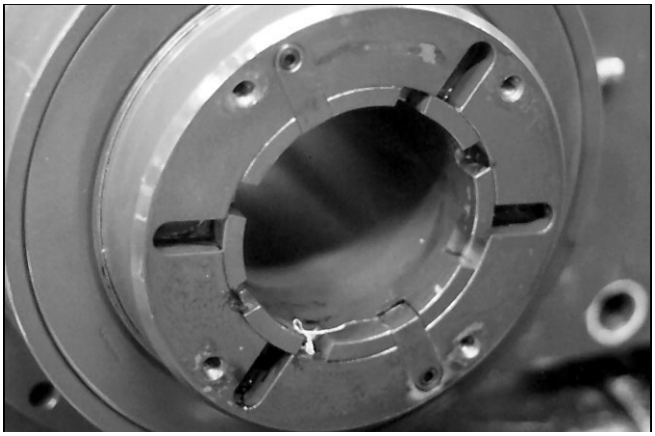
Item 24

25. Remove the four capscrews retaining the bottom guide bushing plate to the spindle nut and remove the plate.



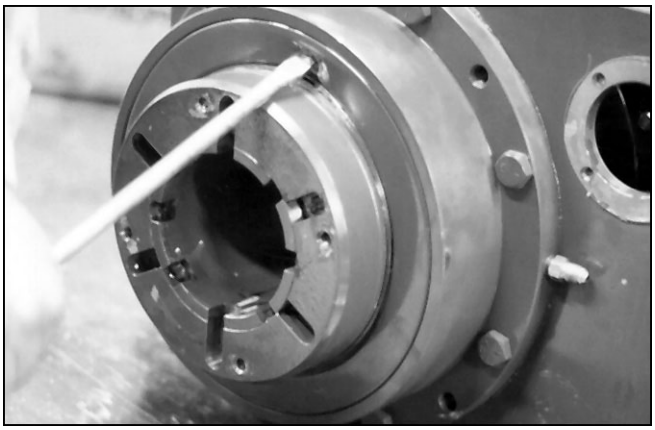
Item 25

26. Remove the two capscrews which retain the bottom spindle nut locking keys and remove the keys.



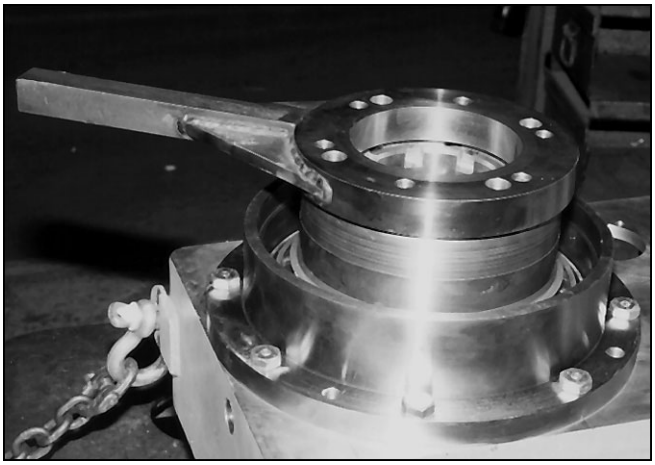
Item 26

27. Remove the bottom spindle bearing oil seal with a screwdriver.



Item 27

28. Turn the head box upside down (bottom spindle bearing cap facing up) and attach a spindle nut removal tool to the bottom spindle nut with four capscrews.



Item 28

29. Lock the final drive spindle sprocket with a 2" x 2" (5 cm x 5 cm) aluminium block to prevent the spindle from turning.

NOTE: This is a right hand thread.

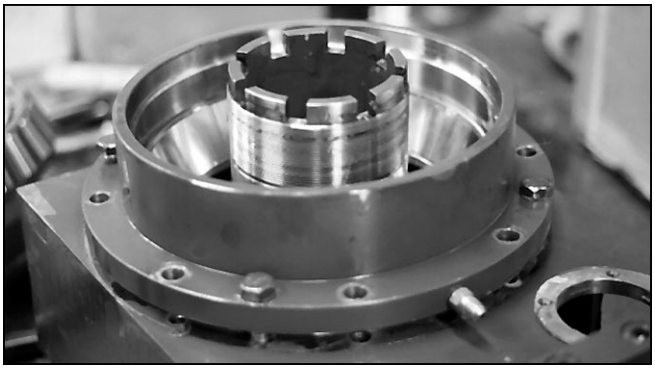
30. Loosen the spindle nut by striking the removal tool with sharp blows from a 5 lb (2 kg) hammer and remove the spindle nut.

31. Remove the bottom bearing cone.

32. Remove the eight bolts retaining the bottom spindle bearing cap.

NOTE: the oil gallery port location (which is sealed with an “O” ring) when the bottom spindle bearing cap is removed. Prior to reassembly, ensure the internal galleries in the head box and the spindle bearing cap are clean and free from debris. During reassembly, use a new “O” ring to seal the mating surfaces of the oil galleries on the head box and the bottom spindle bearing cap. Make sure the oil delivery port is oriented above the internal gallery.

33. Use the four threaded “jacking” holes in the bottom spindle bearing cap to remove this item with the appropriate bolts.



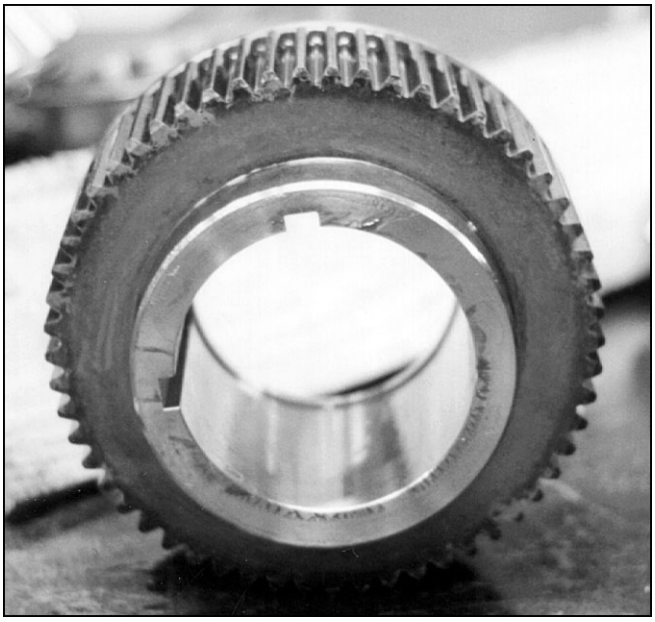
Item 33

34. Remove the bottom bearing shim spacer tube from the spindle.

35. Raise the head box clear of the work bench and firmly support the box with suitable blocks of wood.

36. Tap the spindle down using a block of wood to protect the spindle. The spindle will then slide free of the final drive driven sprocket keys which are spaced at 90 degrees.

Item 36



Actual assembly may not be exactly as shown.

37. Once free from the final drive driven sprocket, the head box can be lifted clear of the spindle, which is now resting on the work bench.

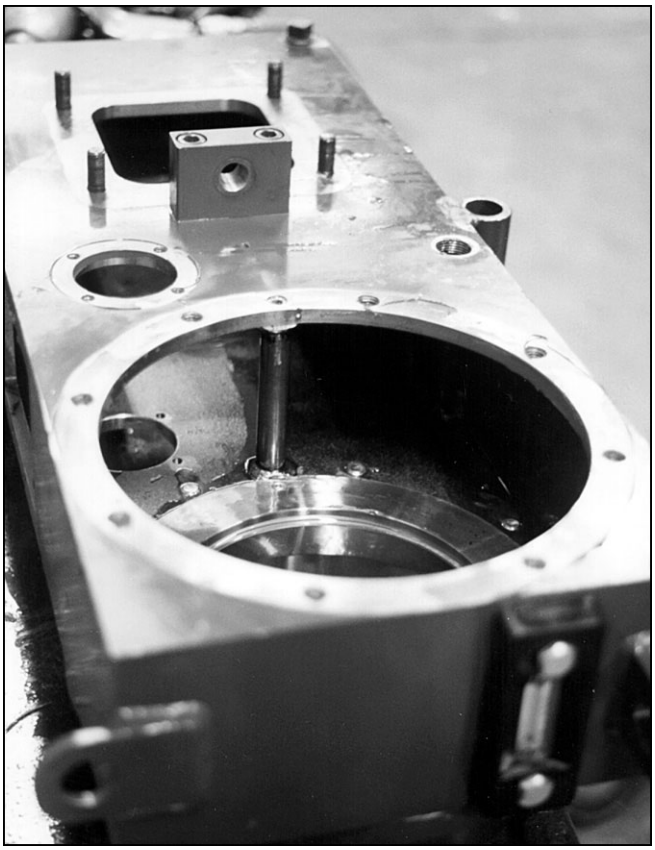
38. The top bearing cone, which is still attached to the spindle, can now be removed by "jacking" the bearing with the appropriate bolts through the threaded holes on the chuck spindle adapter flange.

    Ensure the final drive driven sprocket keys are removed from the spindle before attempting to carry out this operation.

NOTE: the oil gallery port location (which is sealed with an "O" ring) when the top bearing cap housing is removed. Prior to reassembly, ensure the internal galleries in the head box and the spindle bearing cap are clean and free from debris. During reassembly, use a new "O" ring to seal the mating surfaces of the oil galleries on the head box and spindle bearing cap. Make sure the oil delivery port is oriented above the internal gallery.

NOTE: Prior to reassembly, it may be necessary to grind the internal oil tube on some older head box weldments. This will provide the proper clearance required for the driven sprocket used with the roller chain conversion. Carefully grind the tube flush with the large inside diameter of the bearing cap bore inside the head assembly weldment.

39. Remove the eight bolts securing the top spindle bearing cap. Remove the cap by threading the appropriate bolts through the four threaded "jacking" holes on the flange of the cap.



Item 39

40. Thoroughly clean all parts in a suitable bath, taking care to remove all old gasket cement. Make sure that all threads are cleaned with the appropriate sized tap. This is particularly important. Many bolt holes are threaded through the head box and will require a fresh seal during assembly to prevent leakage.

    Take care to ensure that internal oil galleries do not become clogged with debris.

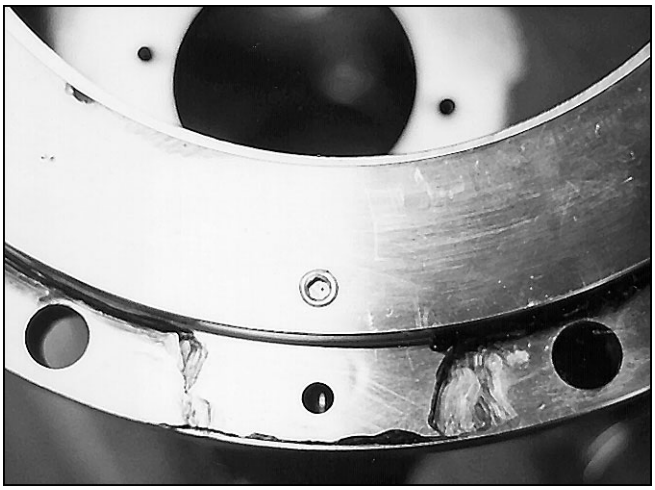
41. Inspect all components for wear or damage prior to assembly. During reassembly, new oil seals must be used for both the top and bottom bearing cones. It is also advisable to have a new drive head chain master link assembly installed.

HQ Rotation Unit Group Drill Head Reassembly

1. Make sure all components have been thoroughly cleaned and inspected prior to reassembly. Ensure all gasket cement has been removed and all threaded holes have been cleaned with the appropriate size tap. (This is particularly important as many bolt holes are threaded through the head box and will require a fresh seal during assembly to prevent leakage). Take care to ensure that all internal oil galleries are clean and unclogged.
2. Place the head box with top (Funk transmission mating surface) facing up.
3. Replace the "O" ring, which seals the internal gallery on the head box and feeds the top spindle bearing. This "O" ring is 1/2" O.D. x 3/8" I.D.

Item 3

4. Apply RTV high temperature silicon sealant to the mating surface on the top spindle bearing cap. Do not use an excessive amount around the oil gallery port, as too much silicon could plug the port.



Item 4

5. Place the top spindle bearing cap on the head box. Make sure to orientate the lubricating oil port in the spindle bearing cap with the internal gallery in the head box.

Item 5

6. Use four longer 1/2" x 1-1/2" UNC bolts to start the top spindle bearing cap onto the head box. This is a pilot fit, so ensure the spindle bearing cap is started and pulled down evenly.
7. Once the spindle bearing cap is snug with the top of the head box, remove the four longer 1/2" x 1-1/2" UNC bolts.
8. Apply a light coating of RTV silicon to the threads of the eight 1/2" x 1-1/4" UNC bolts and tighten these down evenly, using a cross hatch pattern. The silicon sealant on the threads of these bolts will seal the tapped holes in the final drive housing and prevent leakage.

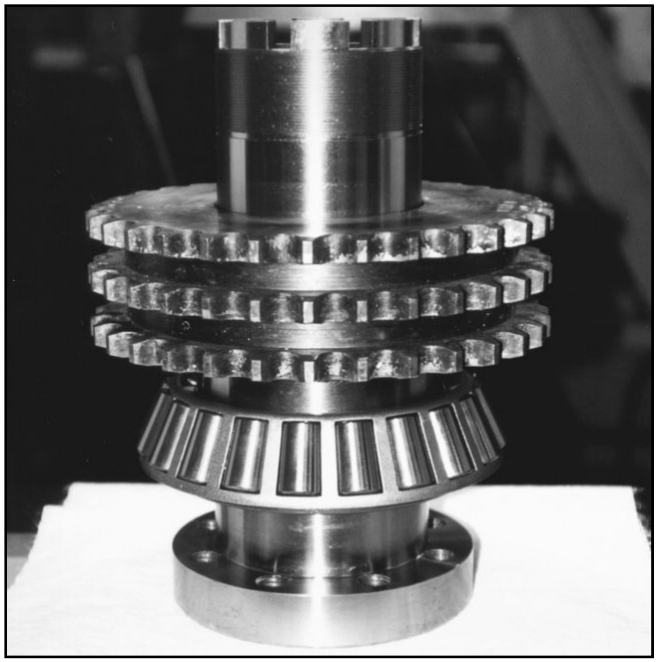
Item 8

9. Torque the eight 1/2" x 1-1/4" UNC bolts to 50 ft lb (68 Nm) in an even cross hatch pattern with a tension wrench.

10. Assemble the top tapered bearing cone onto the spindle with the larger bearing O.D. towards the chuck flange on the spindle.

Item 10

11. Now place the final drive driven sprocket (with the extended boss towards the bearing) onto the spindle. Do not insert the drive keys into the spindle, as the gear will only be used to press the top bearing cone into position against the chuck adapter flange and then removed.



Item 11

12. Use a soft hammer to tap the final drive driven sprocket down to the bearing shoulder. This is a slip fit only and should not be pressed to start the gear.

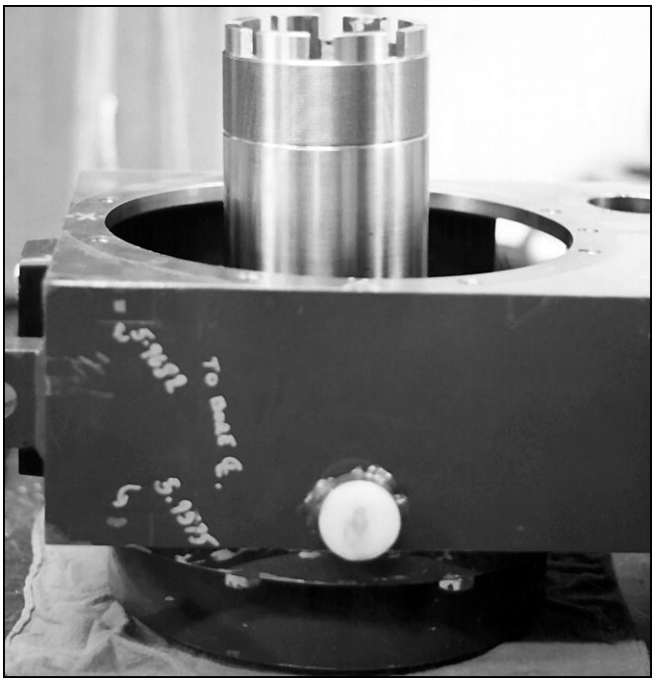
13. Once the final drive driven sprocket has made contact with the top bearing cone, place the spindle in a hydraulic press (resting on the chuck adapter flange) and position a suitable piece of hollow tubing over the threaded section of the spindle onto the final drive driven sprocket. Press the top bearing into position against the chuck adapter flange.

Item 13

14. Remove the spindle from the press and invert the unit so the threaded end is resting on a soft piece of wood on the work bench. Use a soft hammer to evenly tap the final drive driven sprocket off the spindle.

15. Place the spindle on a soft, clean cloth with the chuck adapter flange facing down and the threaded end up.

16. Lift the head box over the spindle and allow the top bearing cup on the head box to gently come to rest on the top bearing cone. Using blocks of wood, evenly position the head box over the spindle.



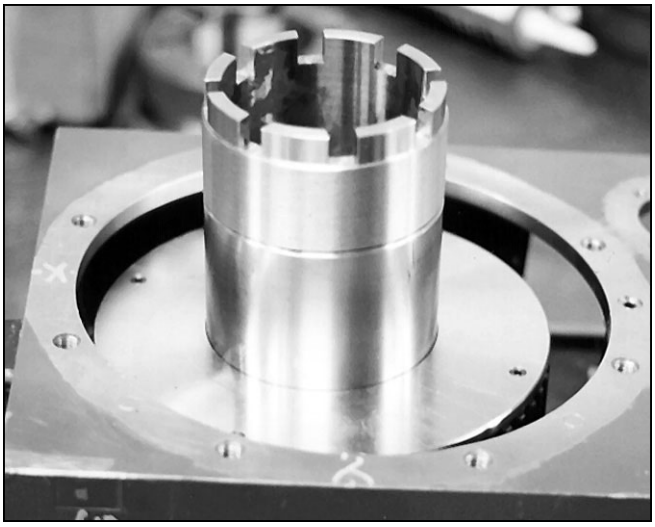
Item 16

17. Apply a light coating of lithium based grease to the spindle area where the final drive driven sprocket comes to rest. Apply the same to the spindle keyways, before inserting the drive keys.

Item 17

For ease of chain installation, it is recommended that a heavy gauge wire be fed through the front of the head box service door and around the spindle. Continue to feed the wire around the inside of the head box so that both ends of the wire end up protruding through the head box front service opening. Be sure to keep the wire tight against the inside walls of the head box to prevent any internal parts interfering with the wire during reassembly.

18. Place the final drive driven sprocket onto the spindle (extended boss toward the bearing). As the final drive driven sprocket is a slip fit onto the spindle, ensure this is started evenly and not forced. Be careful not to get your fingers caught between the final drive driven sprocket and head box as the sprocket slides into place.



Item 18

19. Replace the 1/2" O.D. x 3/8" I.D. "O" ring, which seals the internal gallery on the head box, which feeds the bottom bearing cone.

20. Apply RTV high temperature silicon sealant to the mating surface of the bottom spindle bearing cap. Do not use an excessive amount around the oil gallery port, as too much silicon could plug the port.

Item 20

21. Same as # 5, 6, 7, 8 & 9.

22. Blow compressed air into the bottom spindle bearing cap oil feed port and confirm there is a free flow to both the top and bottom bearing feed holes.

23. Place the bearing shim spacer tube over the threaded end of the spindle and allow the bearing shim spacer tube to slide down onto the driven sprocket.

NOTE: This is a slip fit.

24. Place the bottom bearing cone over the threaded end of the spindle and allow the bottom bearing cone to come to rest on the bearing shim spacer tube.

25. Liberally apply a full thread depth coating of a lithium based grease to the entire spindle thread.

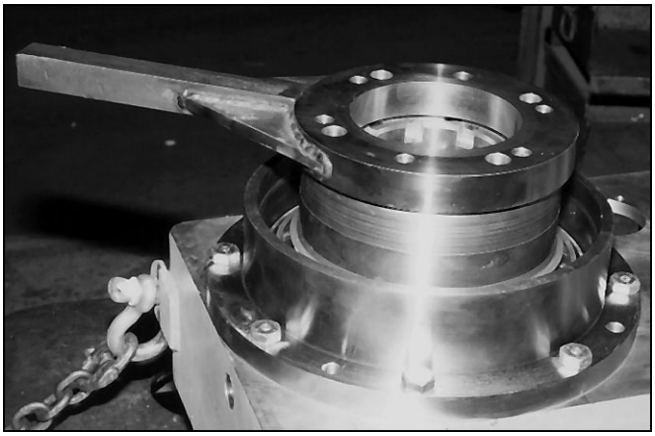
Item 25

26. Before installing the spindle nut onto the spindle, ensure the wear sleeve is serviceable. If there is any doubt, replace it.

NOTE: This is a right hand thread.

27. Liberally apply a full thread depth coating of a lithium based grease to the bottom spindle nut and install this onto the spindle.

28. Once the spindle nut is snug on the bearing cone, install the spindle nut tool onto the spindle nut. (This tool has an I.D. large enough to see when alignment between nut and spindle keyways occurs.)



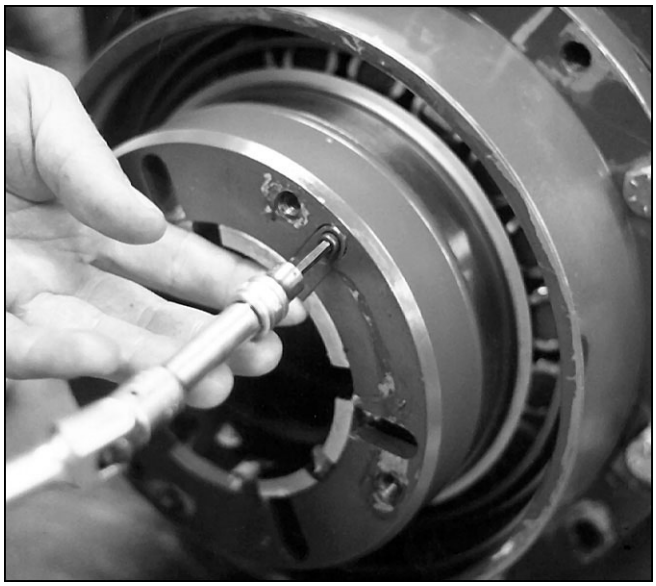
Item 28

29. Next, lock the final drive driven sprocket internally with a wedge or a new aluminium block 1” x 2” x 4” lg (2.5 cm x 5 cm x 10 cm) to prevent the spindle from turning as the nut is tightened with the tool.

30. While keeping tension on the spindle nut tool to prevent the aluminium block that is locking the final drive driven sprocket from dislodging, begin tapping the tool handle with a 5 lb (2 kg) hammer to seat the bearing cone.

Item 30a

When alignment occurs, the nut should be quite firm when the hammer strikes the spindle nut tool.



Item 30b

When the spindle nut is firmly secured, end play on the spindle should be between 0.0005" to 0.0030" (0.012 - 0.070 mm).

To check the end play, place the drive head assembly in the upright position and support the head box with a block of wood. Make sure the bottom of the spindle is clear of the work bench. Attach a magnetic base dial indicator to the head box (near the front service plate port). Place the indicator probe on top of the spindle flange.

Now, place a pinch bar under the spindle and work the pinch bar up and down while supporting the head. The amount of end play can now be measured on the dial indicator.

After determining end play, the spacer must be removed and the thickness machined to obtain specified end play tolerance.

i.e.

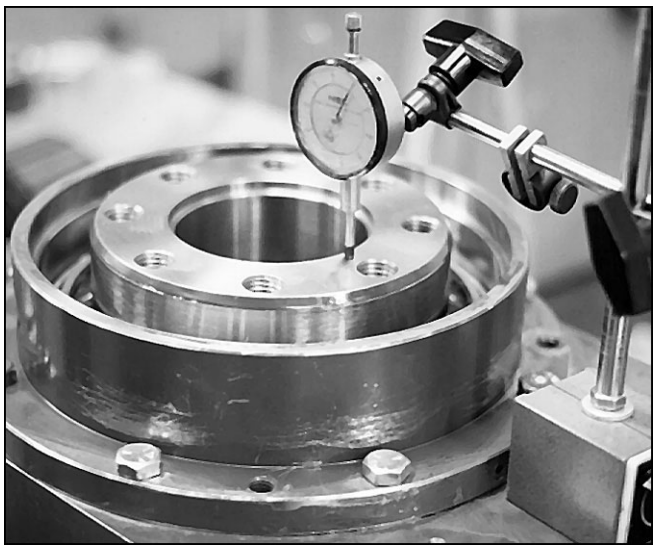
Current End Play - Desired End Play

0.018” (0.457 mm) - 0.0015” (0.038 mm)

= 0.0165” (0.419 mm) stock removal.

Therefore 0.0165” (0.419 mm) must be machined off the spacer face.

Due to the close tolerance to obtain the proper end play, all surfaces concerning spindle end play must be clean and free from burrs. Also the machining of the spacer must be precise.



Item 30c

NOTE: After machining the spacer to the proper thickness, repeat steps #23 to #25, and #27 to #30.

When alignment occurs, the nut should be quite firm when the hammer strikes the spindle nut tools. If for any reason you cannot reach the next intended keyway, and have to back the spindle nut off, do not just back off to the nearest keyway. You should back off at least one full turn, and then once again, now advance the spindle nut to the intended keyway. Insert the two spindle nut locking keys into the spindle nut and retain with their respective cap screws.

CAUTION **Ensure that the transmission shim is lightly siliconed to the transmission mounting face.**

31. Place the "O" ring, which seals the Funk transmission onto the head box, into its machined groove. Retain the "O" ring with a small amount of lithium based grease.

NOTE: Apply RTV sealant to the bolt threads. Install new rear cover transmission seal. Coat the new spacer O.D. with lithium based grease and install on output shaft, and in new seal. Apply a bead of RTV sealant to the spacer face and install new drive sprocket. RTV sealant will seal between spacer and sprocket.

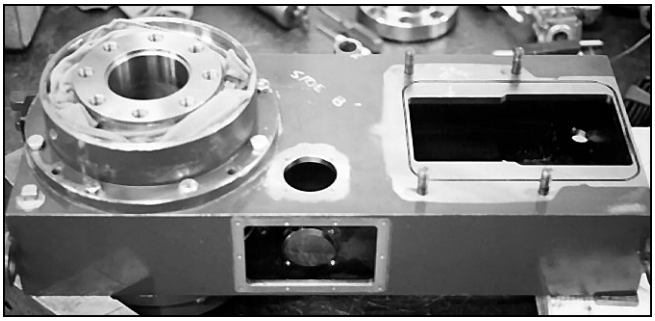
NOTE: Test fit the new sprocket on output shaft to obtain proper location of access hole to install cotter pin in output shaft. Apply RTV sealant inside drive sprocket around output drive shaft to seal the spline. Install hardened washer, nut and cotter pin. Install new transmission shim. Remove old RTV sealant from transmission drain plug and reinstall with a coating of new RTV sealant.

Item 31

Remove transmission oil drain plug to drain all oil from transmission. Remove cotter pin, nut and hardened washer from the drive sprocket. Remove drive sprocket and seal from the rear cover plate. Remove the two 3/8” bolts (closest to spindle) from the rear cover and replace with two 3/8” button head bolts from the conversion kit.

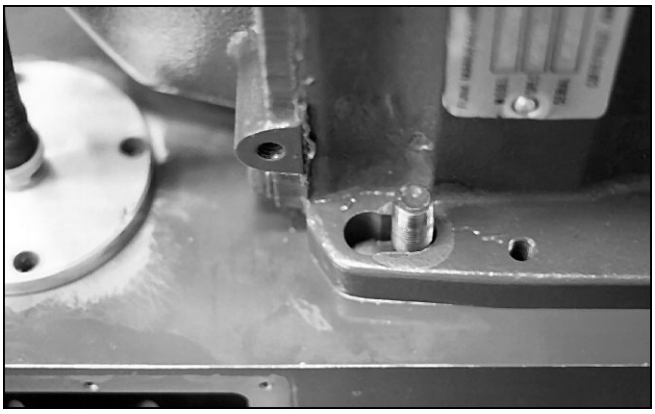
NOTE: The Funk transmission must slide freely in the head box. If it cannot move back and forth freely in the provided cutout, it must be removed from the head box. After the transmission has been removed, remove the six bolts from the rear cover plate. Now the cover plate can be removed. To square the rear cover plate to the Funk transmission, use two 3/8" x 1" bevel head cap screws. Install one in each corner of the rear cover to square it up. Clean the six original bolts of RTV sealant, apply new sealant and reinstall, removing the two bevel head cap screws. Be sure that the two button head cap screws are located in their proper location, closest to the spindle.

32. Lower the Funk transmission and adapter housing onto the head box.



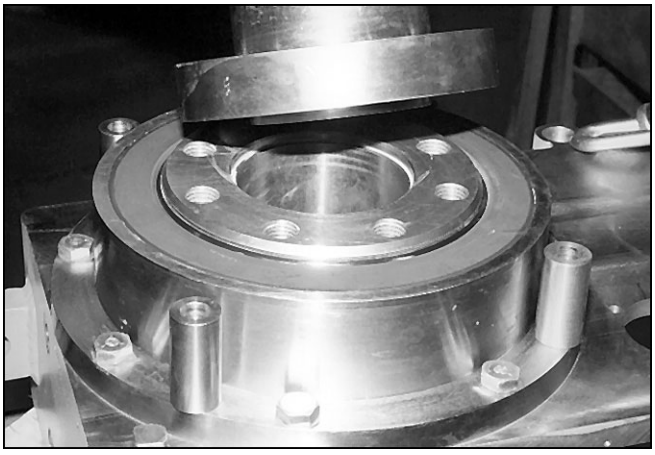
Item 32

33. Place four flat washers over the transmission mounting studs, then add the four 1/2" UNF all steel locknuts. Ensure the transmission assembly is as close as possible to the spindle on the housing slots, then snug the locknuts down.



Item 33

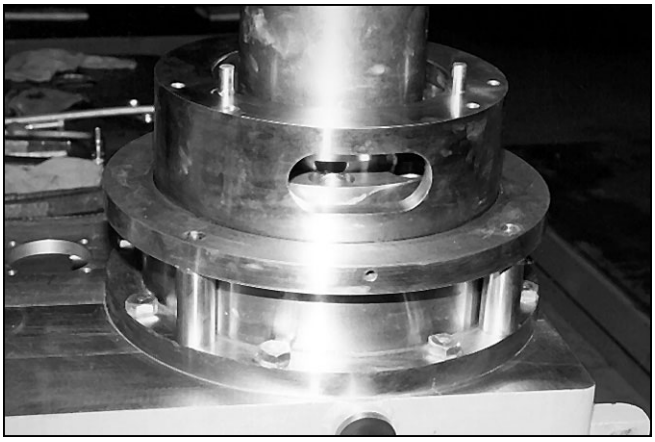
34. Next, lubricate the I.D. of the oil seal and O.D. of the wear sleeve with a lithium based grease. Fit the oil seal into the top spindle bearing cap. Ensure the wear sleeve is in place on the spindle. The seal should be started evenly and tapped home with a soft hammer. When correctly seated, the seal is flush with the top of the spindle bearing cap.



Item 34 and 35

35. Assemble the chuck spindle adapter onto the spindle flange. This has a pilot fit bore. Using blue “Loctite 262”, secure the eight 3/4" x 1-1/2" UNC cap screws to a final torque of 250 ft lb (340 Nm). This should be accomplished using a cross hatch pattern and done at intervals of 75 ft lb (102 Nm), 180 ft lb (244 Nm), and 250 ft lb (340 Nm).

36. Fit the chuck cylinder adapter plate to the top spindle bearing cap. This has a pilot fit bore, so ensure it is started evenly. Place the four spacer tubes under the adapter plate and use four 1/2" x 3-1/2" UNC bolts and lock washers to secure the adapter plate to the four tapped “jacking” holes in the top spindle bearing cap. Torque the four UNC bolts down to 50 ft lb (68 Nm) using a cross hatch pattern in incremental steps.

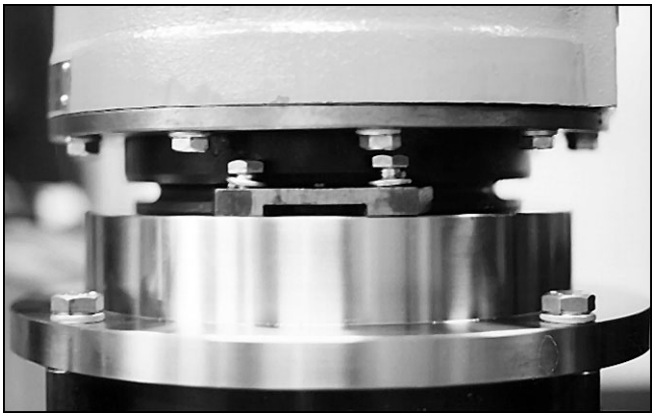


Item 36

37. Fit the three dowel pins from the auto chuck adapter kit to the chuck cylinder adapter plate.

38. Place the auto chuck cylinder on the adapter plate, ensuring that it is properly located on the dowel pins.

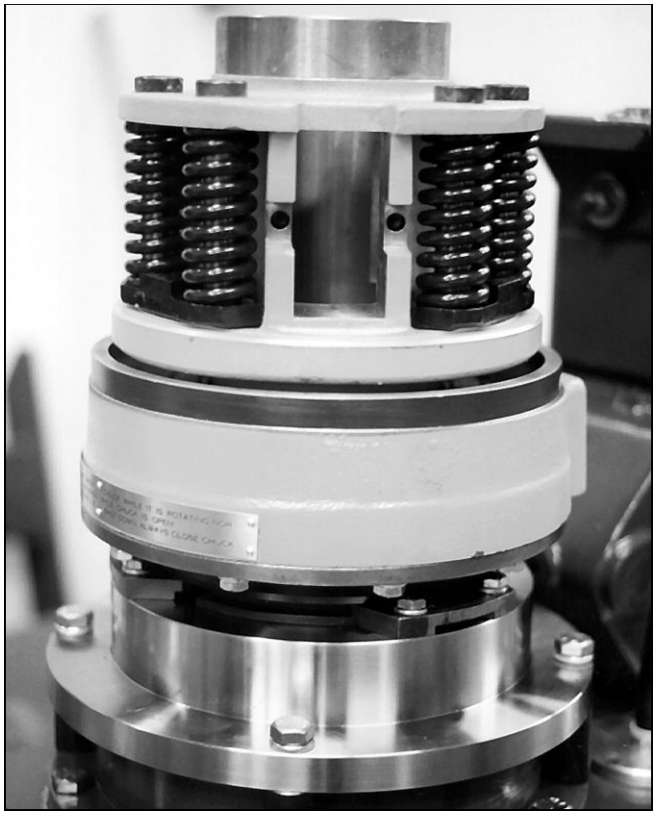
39. Fit the auto chuck cylinder clamps to the base of the auto chuck and secure to 30 ft lb (40 Nm).



Item 39

NOTE: This is a left hand thread.

40. Place the segmented sealing ring (51508) onto the chuck adapter spindle. Now, generously lubricate the chuck body sleeve with a lithium based grease and position this on top of the segmented sealing ring. Next, screw the chuck body onto the adapter flange.



Item 40

41. Next, refit the rotation motor into the adapter shaft and Funk adapter box. Ensure the "O" ring on the rotation motor flange boss is serviceable prior to doing this. Use spring washers, then torque the two mounting flange bolts down to 240 ft lb (325 Nm).

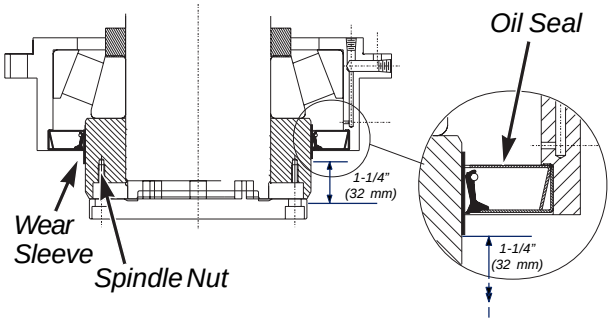
Item 41

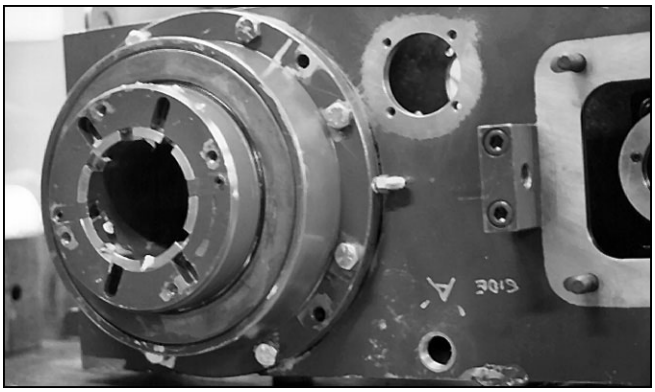
42. Lubricate the appropriate chuck jaws and springs with lithium based grease and fit these to the chuck body.

43. Fit a new wear ring to the chuck hood and assemble the chuck hood to the chuck body with the three shoulder bolts. Tension these to a final torque of 150 ft lb (205 Nm).

44. Turn the drill head onto its back, which will allow access to the bottom spindle bearing cap. Lubricate the I.D. of the oil seal and the O.D. of the wear sleeve with a lithium based grease. Fit the oil seal into the bottom spindle bearing cap. Ensure the wear sleeve is in place as shown, 1-1/4” (32 mm) from the bottom of the spindle nut.

    The seal should be started evenly and tapped home with a soft hammer. When correctly seated, the seal is flush with the bottom of the spindle bearing cap.



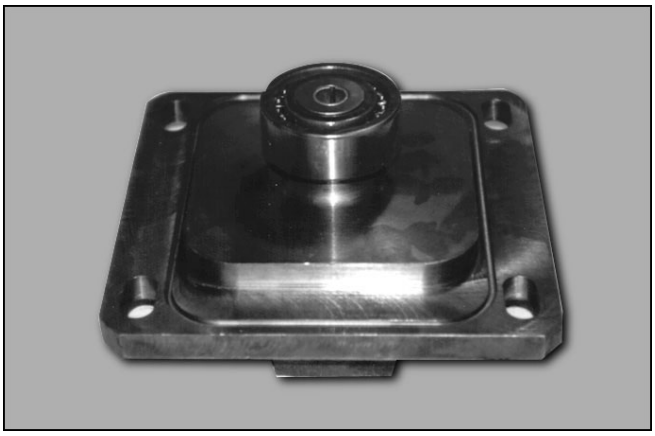


Item 44

45. Refit the bottom rod bushing guide plate to the bottom bearing nut using four 3/8" x 3/4" UNC cap screws.

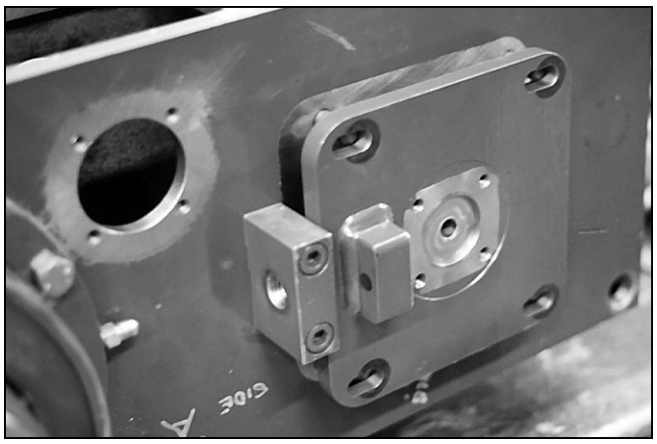
    Using a gear puller, remove the two original bearings off the pinion carrier. Using an arbour press or soft faced hammer, install the new bearing.

46. Fit a new “O” ring to the final drive pinion carrier plate and install this onto the four studs on the bottom of the head box. As this is a piloted fit, the final drive pinion carrier plate will have to be tapped into position. When doing this, ensure the “O” ring does not become dislodged. (A small smear of grease on the “O” ring should hold it in place.)



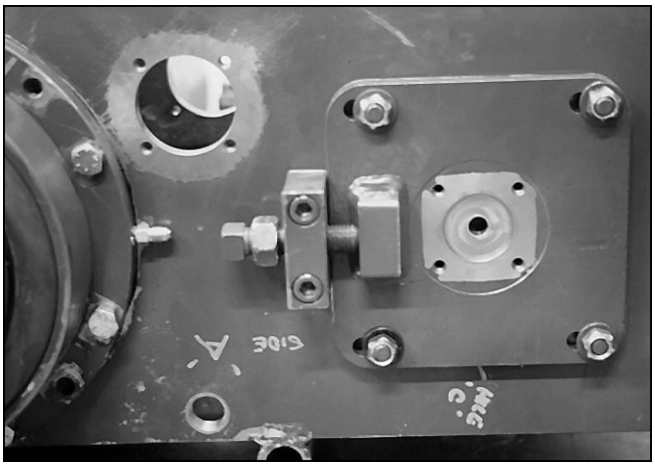
Item 46a

Once the final drive pinion carrier plate has started evenly, with the “O” ring remaining in place, pull the plate into position with the four 1/2" all steel UNC locknuts.



Item 46b

47. Place the Funk transmission in neutral and rotate the drive gear by hand to ensure the final drive pinion sprocket bearings are not binding.

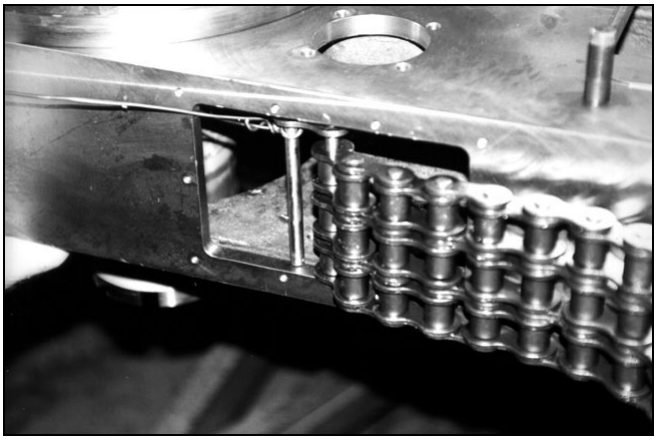


Item 47

NOTE: The following step may be omitted if the wire was installed as described in step #17

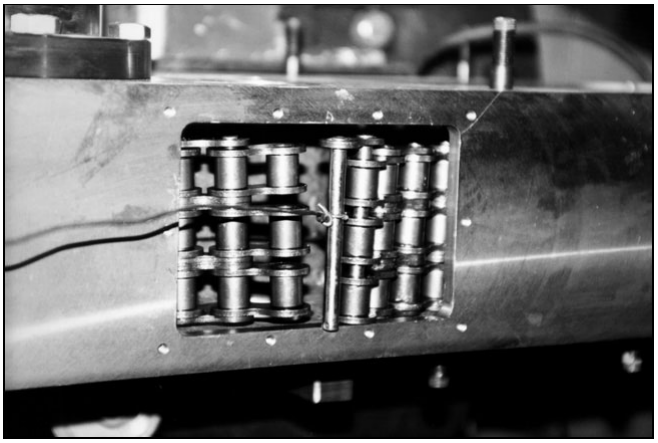
48. Refit the drive head chain tensioning square head set screw and hex nut, but do not adjust (ie. the drive train assembly should be as close to the spindle as possible).

49. Feed a thin piece of wire through the front of the head box service door and around the final drive driven sprocket. Continue to feed the wire around the final drive pinion sprocket so that both ends of the wire end up protruding through the head box front service opening.



Item 49a

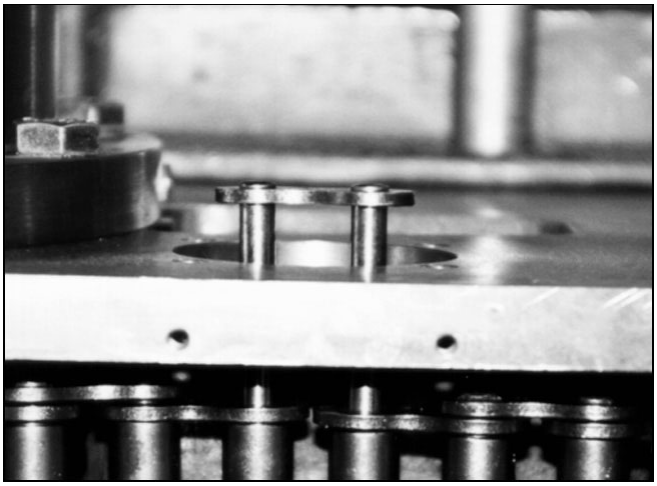
Attach the drive head chain to the end of the wire which wraps around the final drive driven (spindle) sprocket. (Tie the wire to one shaft of the master link and install the other shaft of the master link in the chain.) Keep tension on the other end (final drive sprocket) of the wire and rotate the spindle. This will feed the chain around the sprockets until both ends are at the front service plate opening.



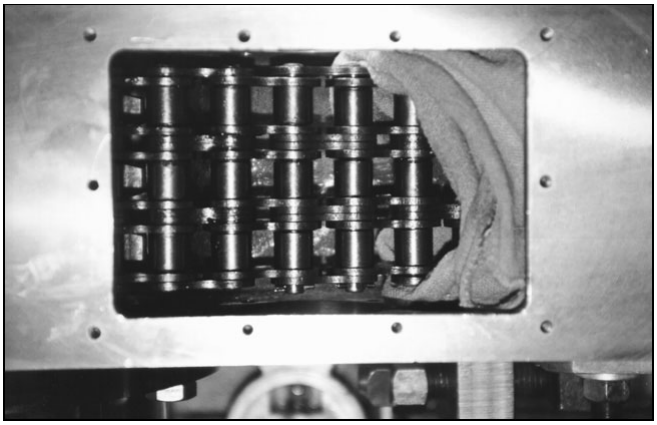
Item 49b

NOTE: Before undertaking the above, a clean rag should be inserted through the top and bottom chain link service ports and under the drive head chain. Spread the rag out in the event that the roll pin, which is to be inserted in the remaining half of the master link, is dropped into the head box.

50. Install master link (link shafts facing direction of pinion carrier). Sequence consists of: master link; one set of rollers; two links; one set of rollers; two links; one set of rollers; one link; and two split pins. Install split pins by holding each pin individually with needle nose pliers and pressing it in with a pair of slip joint pliers. Split the difference and spread the split pin open on both ends of the master link shaft with a small chisel or screwdriver and hammer.



Item 50a



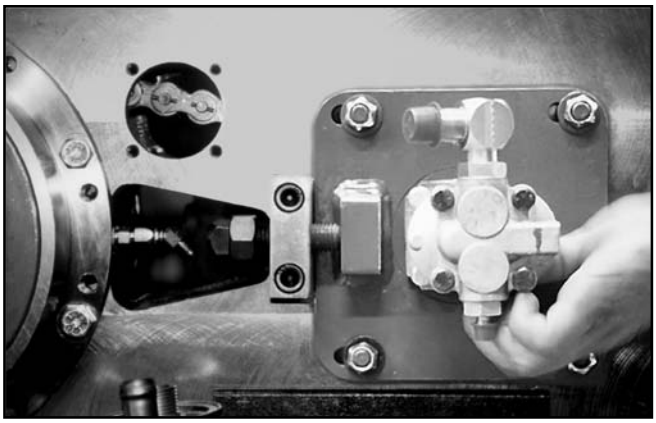
Item 50b

51. After installing the master link, back off the four lock nuts on the transmission and the four lock nuts on pinion carrier just enough so that the drive head chain tensioner can move the transmission and carrier easily. By using the chain tensioner, adjust the chain to obtain 0.625” to 0.875” (15,9 mm to 22,2 mm) of play. Tighten the four lock nuts on the Funk transmission and torque the four lock nuts on the pinion carrier to 50 ft lbs (68 Nm).

52. After adjusting chain the appropriate tension, lock the adjusting setscrew in position with the lock nut.

53. Next, lubricate the oil pump drive shaft with lithium based grease and insert it into the final drive pinion carrier plate. Make sure the male drive end engages into the pinion sprocket drive shaft. When correctly positioned, the oil pump drive shaft extends approximately 0.050" (1.3 mm) past its bushing.

54. Apply RTV silicon sealant to the flange of the hydraulic gear pump and secure this to the final drive pinion carrier plate with four 5/16" x 3/4" UNC bolts and spring washers. The correct orientation of the hydraulic gear pump is with the ports at 90 degrees to the horizontal axis of the head box. With the drill head laying on its back, the larger suction port is closest to the front service opening of the head box.



Item 54

55. Check the driven head chain tension through the bottom chain link service port using a ruler. The amount of play in the chain at the service port should be 1/2" to 3/4" (1 to 2 cm) forward and backward. This should be undertaken using hands only and **not** prying with a screwdriver or levers.

    If necessary, adjust the drive head chain tension with the adjusting set screw on the final drive pinion carrier plate as follows:

    A) Loosen the four 1/2" all steel locknuts on the final drive pinion carrier.

    B) Loosen the four 1/2" all steel locknuts which secure the Funk transmission.

    C) Adjust the drive head chain to the correct tension using the adjusting set screw on the final drive pinion carrier plate. Once achieved, lock the adjusting set screw in position with the locknut.

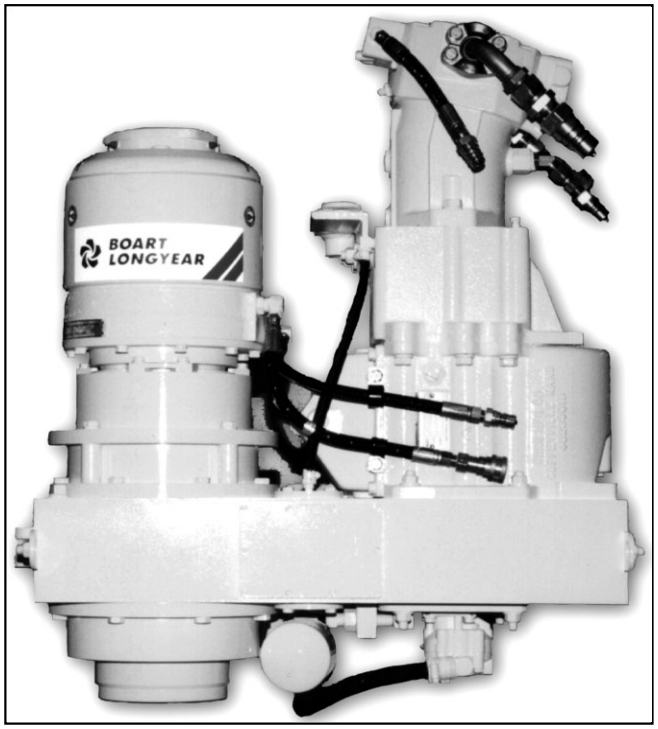
    D) Tighten the four final drive pinion carrier plate all steel locknuts prior to tightening the four Funk box all steel locknuts down.

    E) Once the four Funk box all steel locknuts are snug, loosen the four final drive pinion carrier plate all steel locknuts, then, retighten them to 50 ft lb (68 Nm).

    F) Ensure the correct drive head chain tension has been maintained, then, loosen and retighten the four Funk box all steel locknuts to 50 ft lb (68 Nm).

56. Once the drive head chain has been correctly tensioned, check that the drill head hinge pin (bottom centre of head box) aligns in its two respective bores on upper hinge support and lower hinge plate. If the chain adjustment has affected the hinge pin alignment, reposition the flat washers behind the upper hinge bore to regain correct alignment.

Item 56a

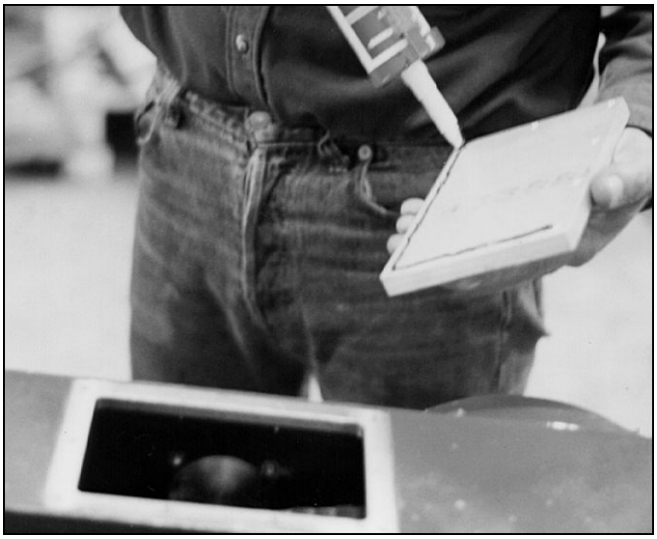


Item 56b

57. Rotate the entire internal drive drill head components by hand to ensure the unit is free to turn and not binding anywhere.

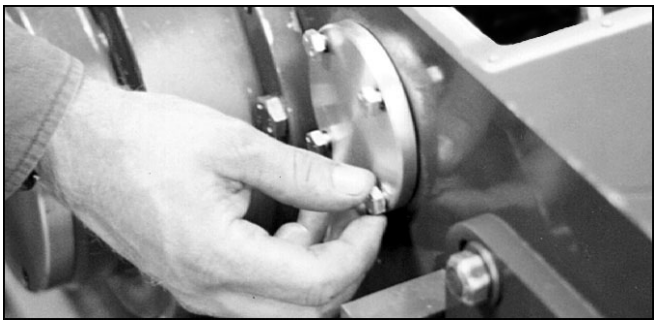
58. Apply RTV silicon sealant to the bottom chain link service cover and fasten this with four 5/16" x 3/4" UNC bolts and spring washers. Coat the threads of the bolts with RTV silicon sealant to prevent leakage from the head box.

59. Apply RTV silicon sealant to the front service plate and secure with the ten 10-24, 1/2" machine screws (cap screws). Seal the threads of these with silicon to prevent leakage from the head box.



Item 59

60. Apply RTV silicon sealant to the top, threaded, chain link service cover and secure with the four 5/16” x 3/4” UNC bolts. Seal the threads with silicon to prevent leakage from the head box.



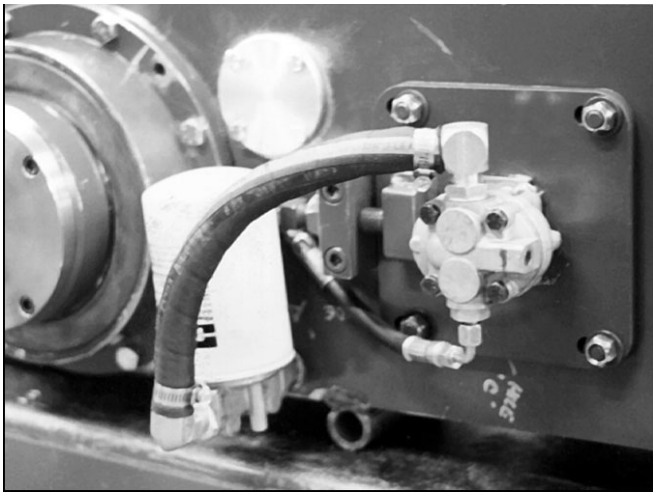
Item 60

61. Replace suction hydraulic oil filter and fasten the oil filter housing onto the head box. Use a hydraulic sealant on the threaded port in the head box.

Item 61

62. Replace the hydraulic gear pump suction hose and clamps.

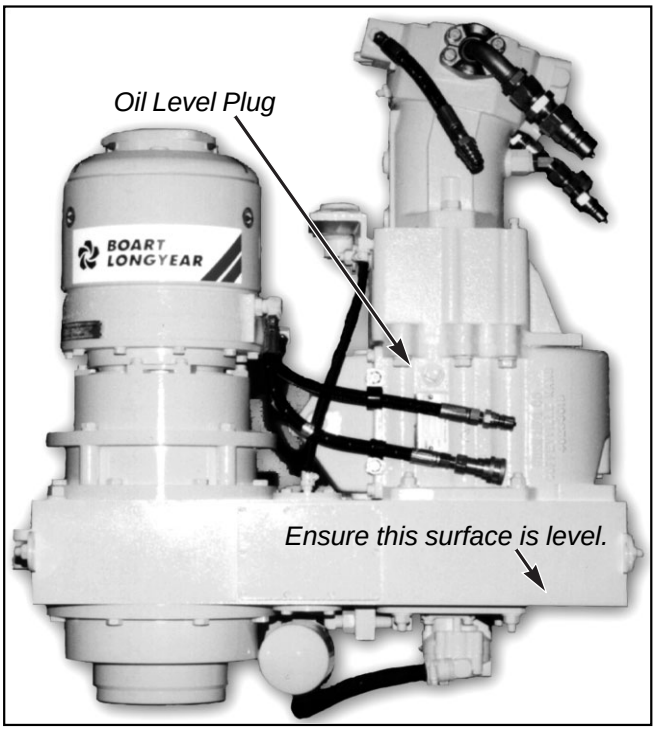
63. Replace the hydraulic gear pump pressure hose to the bottom spindle bearing cap.



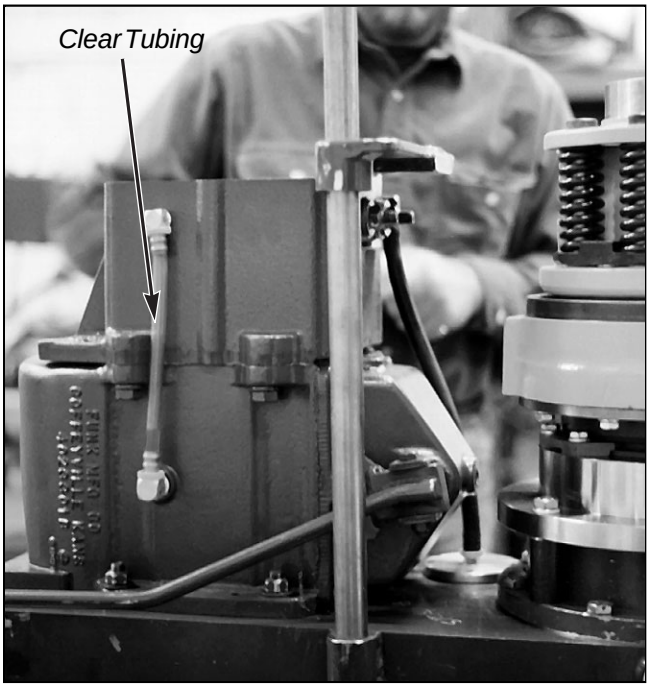
Item 63

CAUTION **Do not overfill. To do so will result in overheating.**

64. Refill the Funk transmission assembly to the correct level with engine oil (original factory fill quantity is 8 quarts U.S. (7,5 L)). Refer to page 9-05 for a list of lubricants. With head assembly in the vertical position and no spindle rotation, the maximum or full level will be when oil reaches the oil level plug located on front face of transmission. This oil level can also be monitored through the clear tubing on the back side of the head assembly.



Item 64

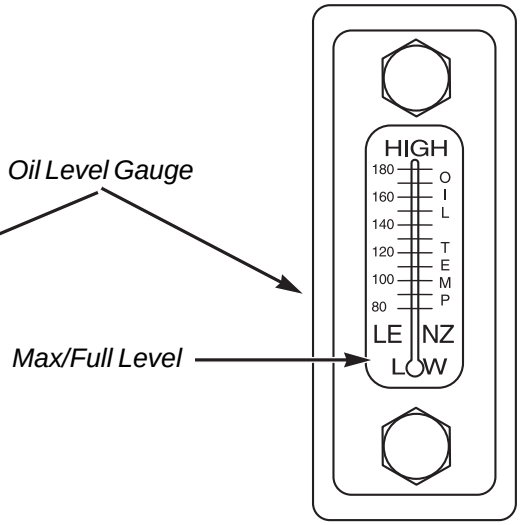


NOTE: Drill assembly must always be level.

CAUTION **Do not overfill. To do so will result in overheating.**

65. Refill head box to the correct level with hydraulic oil (original factory fill quantity is 7 quarts U.S. 7.5 L). Refer to page 7-11 for a list of lubricants. Drill assembly must be level in all directions. With head assembly in the vertical position and no spindle rotation, the maximum or full level will be at the **lower** end of the 3" oil level gauge located on operator's side of the head box.

(**NOTE:** Actual equipment may not be exactly as shown)



Temperature gauge is measured in degrees Fahrenheit (°F).

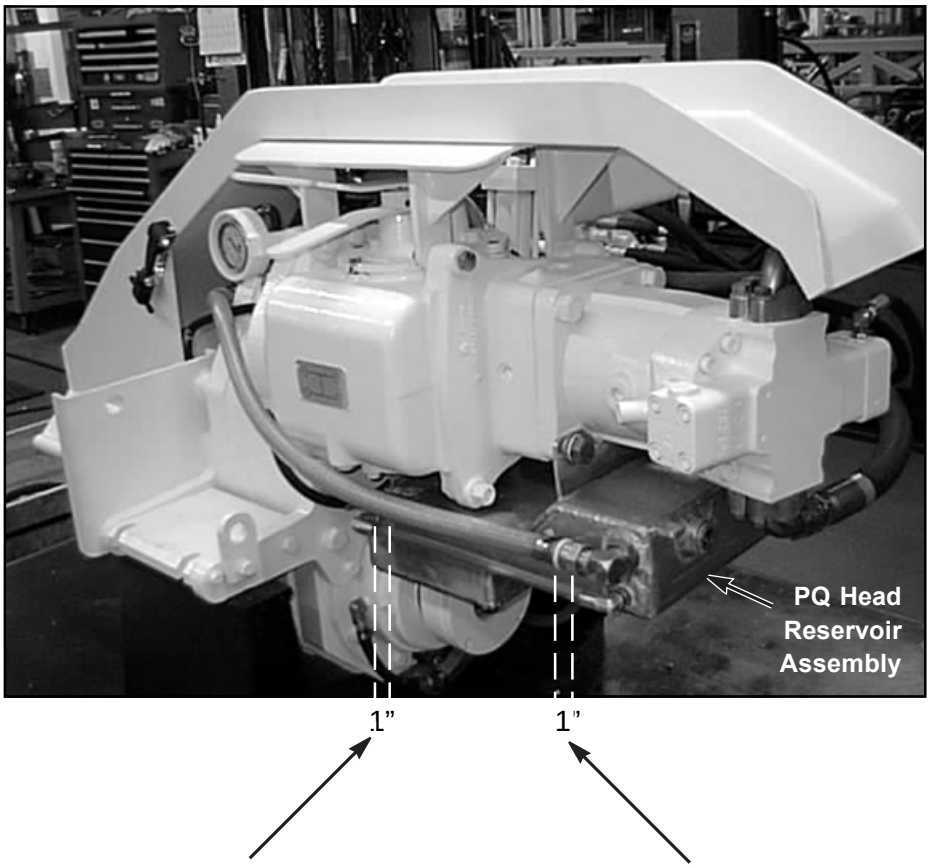
Conversion to degrees Celsius (°C):
(°F) x 0.556 = (°C)

PQ Head Drive Group (Optional)

The PQ Head Drive Group is situated in the drill carriage on the 11 ft (3.4 m) mast section. This drive group consists of a two-speed variable displacement bent axis hydraulic motor, a four-speed mechanical transmission, a 2:1 drive ratio gear box with a straight cut gear set, PQ Chuck, high pressure filter and chuck/head guard.

The final drive of the rotation unit is through the 2:1 gear box out to the spindle. The PQ Chuck is used to transmit the rotary power of the drill head to the drill string.

(**NOTE:** Actual equipment may not be exactly as shown)



To check the maximum or full level when the spindle is not rotating, the oil level should be 1” (25 mm) below the top elbow of the sight tube when the head is in a vertical position.

To check the maximum or full level when the spindle is rotating in 4th gear at 1250 rpm, the oil level should be 1” (25 mm) above the bottom elbow of the sight tube when the head is in a vertical position.

In order to convert an existing LF 70 drill from the HQ to the PQ head the following steps are required:

1. With suitable lifting equipment, remove the existing HQ rotation unit from the head carriage on lower mast section. Use the three lifting points provided.
2. Replace existing top plates with new top plates. The pivot pin, 3/4”-10 capscrew and 3/4” flatwasher should be transferred to the new top plates.

Head Slide Wear Bars Field Maintenance Check and Adjustment

3. If converting a drill which was manufactured before September 1, 1997 a new Crown Block c/w 30” Sheave will be required for use with the new PQ head. If drill is already equipped with this single sheave crown block, then it will have to be moved outwards to match the 2” difference in offset of the PQ head centerline. The crown block has an extra set of holes to accommodate this requirement.
4. Replace or rework existing rod slides (in upper and middle mast sections) with new rod slides.

5 Replace existing pivot rod centralizers (in upper and middle mast sections) with new centralizers.

6 Replace existing support legs (on base frame assembly) with new support legs.

7. Replace existing casing positioner base assembly with new base, base mounting bar and new hardware provided with conversion.

   A new adapter plate is also supplied which is used for adapting to the existing casing adapter collars and casing guide bushings.

   If drill was equipped with the rod clamp option it will be necessary to rotate the assembly 90º clockwise which will position the hose quick couplers downward or towards the drill frame. This is done in order to provide necessary clearance for bottom of PQ head rotation motor.

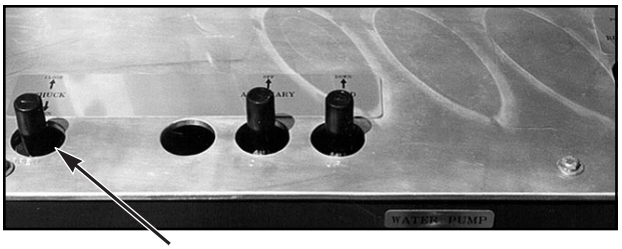
8 Replace existing rod guard drawing with new PQ rod guard.

PQ Head Installation

1. With suitable lifting equipment, carefully place the PQ head onto the head carriage while lining up pivot point with new hinge pin provided with PQ drive group. Lifting eye bolts are provided for this.
2. Lock head into place with the pivot pin bolt on left side top plate.
3. Ensure head is filled to the correct level with hydraulic oil (original factory fill quantity is 9 quarts U.S. (8.5 L)). Drill must be level in all directions with head assembly in the vertical position and no spindle rotation, the maximum or full level will be when the oil reaches the oil level plug located on front left side of transmission. This oil level can also be monitored through the clear tubing (Ø3/4" drain line) on the right side of head.

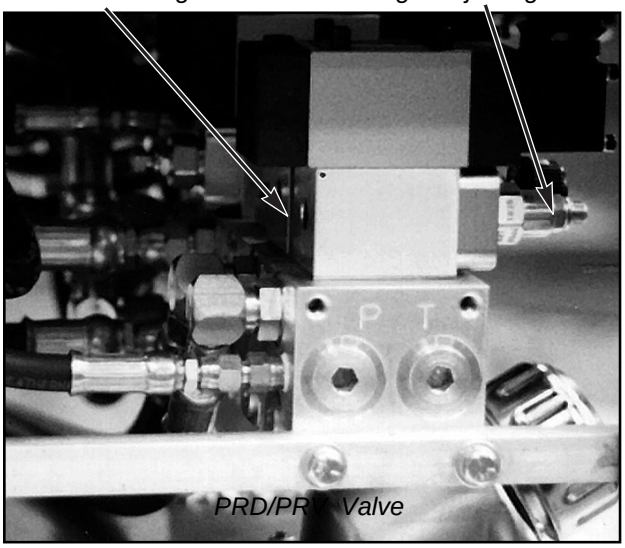
⚠ WARNING **Do not overfill. To do so can result in overheating.**

4. Reconnect the head hoses to corresponding quick couplers on head.



Chuck Mode Selector Valve

1/4" NPTF Plug *Cartridge Adjusting Screw*



PRD/PR Valve

5. Readjust the pressure reducing/relief valve (on drill) as follows:

Install a pressure gauge 0-1500 psi (0 - 10350 kPa) in place of the 1/4” NPTF plug located on the back side (opposite cartridge adjusting screw) of (PRD/PRV) valve.

Sandwiched below this valve is a pressure reducing valve (PRD) / pressure relief valve (PRV)

With the selector shifted to open the PQ chuck, turn the cartridge adjusting screw in (clockwise) to increase pressure setting to 1200 psi (8274 kPa) and tighten locknut.

Replace gauge plug on back side of (PRD/PRV) valve.

Once set, this should not be altered during normal operation.

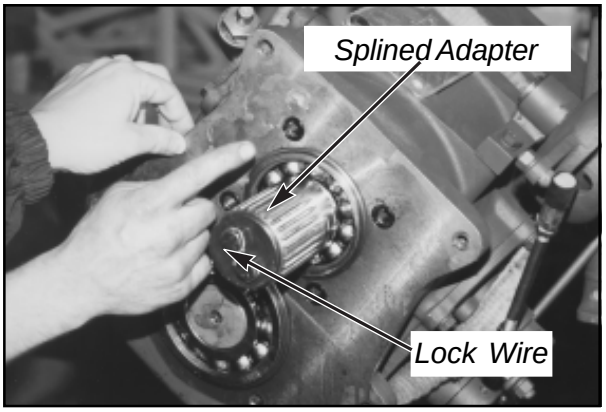
PQ Head Disassembly Procedures

NOTE: It is recommended that the head assembly be disassembled in a shop environment with the use of overhead lifting capabilities. This will be required to move and support the PQ Head.

1. Open the chuck and insert the lifting bail which was supplied with the chuck. Remove the spindle nut bushing. Disconnect all hydraulic hoses to the rotation motor and chuck.
2. Drain the head and transmission of oil. This can be accomplished by removing a return line hydraulic hose from the transmission. The position of the drill feed frame will determine which hydraulic return line to remove.
3. Remove the head unit from the drill before starting disassembly of the unit.
4. Place the head on a solid work table and block it up to support it. Lay the head down so that the spindle is horizontal to the work table.
5. Remove all hoses, fittings, gear shift lever etc. from the head (all external components).
6. Remove the chuck with either the lifting bail or a suitable lifting sling.
7. Remove the mounting group brackets and/or bulkheads.
8. Remove the four bolts which hold the rotation motor assembly. The motor is siliconed to the transmission and will have to be pried off to break the seal.
9. Support the transmission, preferably with the aid of a crane and sling arrangement. Remove the six mounting bolts that secure the transmission to the input carrier.

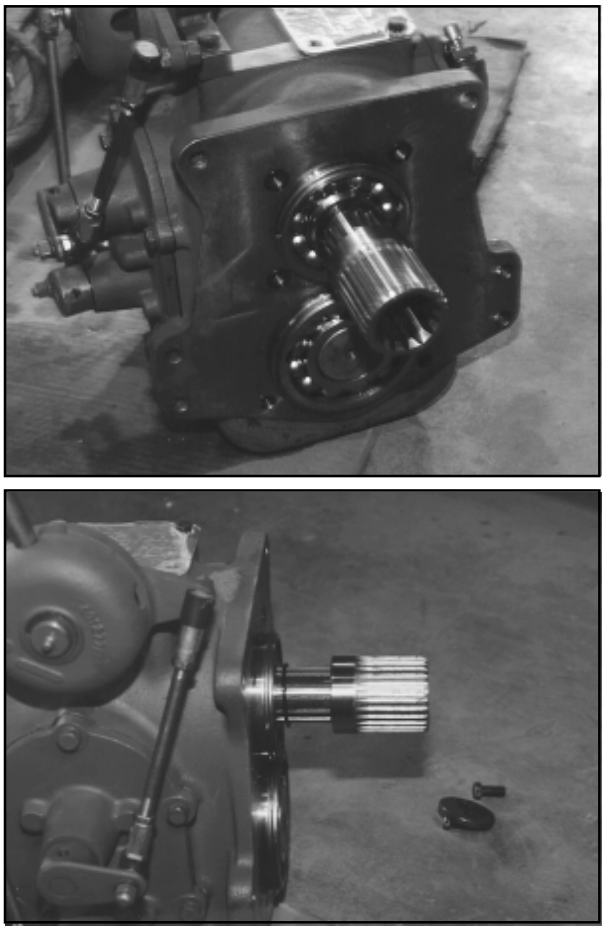
NOTE: The silicone seal, between the transmission and the input carrier, will have to be worked apart in order to remove the transmission.

10. Carefully slide the transmission back and out of the main housing.



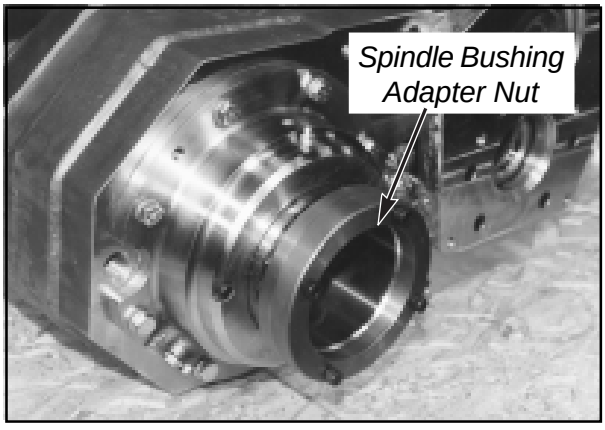
11. Remove the lock wire from the two bolt heads on the retaining washer on the transmission output shaft.
12. Remove the two bolts, retaining washers and shim pack.

13. Slide the splined adapter forward off the transmission output shaft.

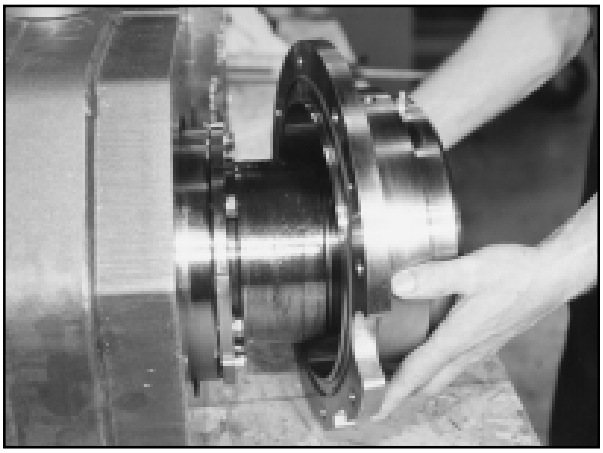


NOTE: This is a right hand thread.

14. Remove the spindle bushing adapter nut.

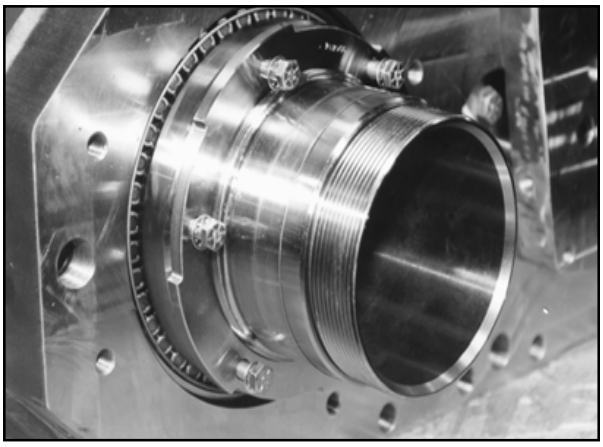


15. Remove the bolts from the lower carrier seal. Using the existing 1/2” UNC jack screw holes, remove the lower carrier seal.

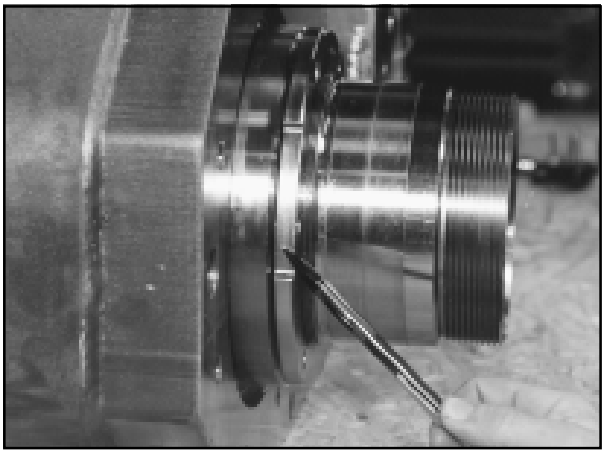


16. Using a punch, drive out the two oil seals.

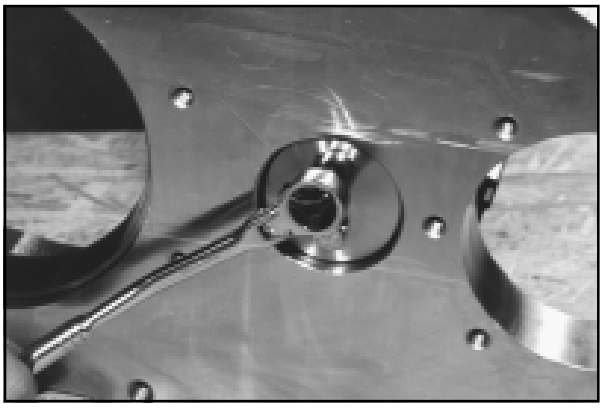
17. Remove the six 3/8” UNC bolts and internal tooth lock washers from the outer locking ring.



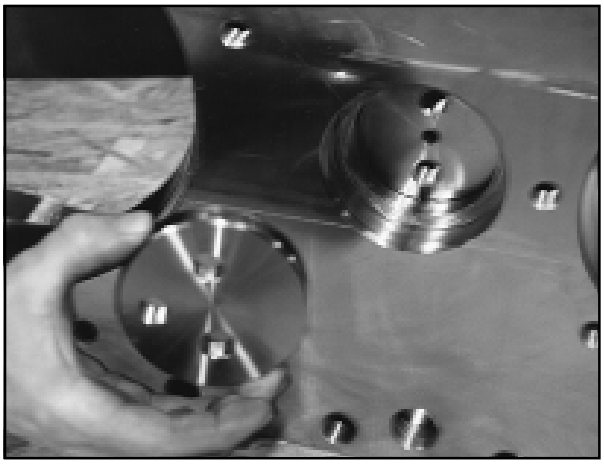
18. Thread off the outer locking ring.



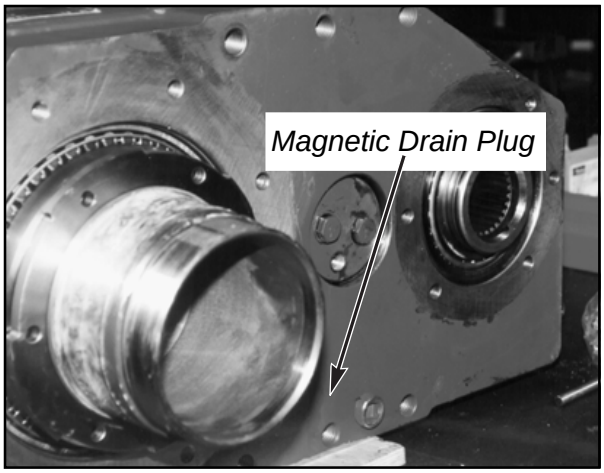
19. Remove the two 1/2” UNC bolts from the intermediate lock plate.



20. Remove the intermediate lock plate. This plate will have to be pried off due to a silicone seal.

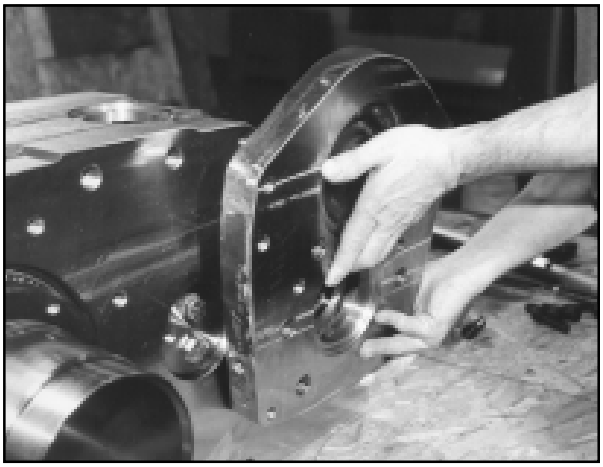


21. Remove the 3/4” NPT plug from the bottom of the main housing. This is a magnetic plug and must be cleaned.



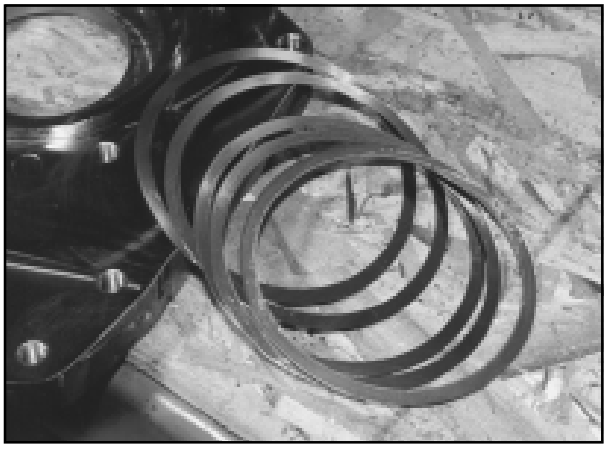
22. Using a 3/8” Allen wrench remove the six 1/2” UNC capscrews from the input carrier.

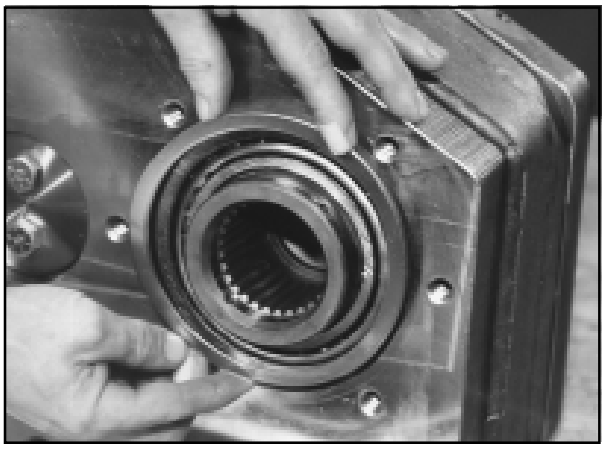
23. In the 1/2” UNC jack screw holes, insert two bolts and remove the input carrier.



24. **NOTE:** After removing the input carrier, remove the shim pack from inside the input shaft bore.

25. Check to make sure all shims are located.

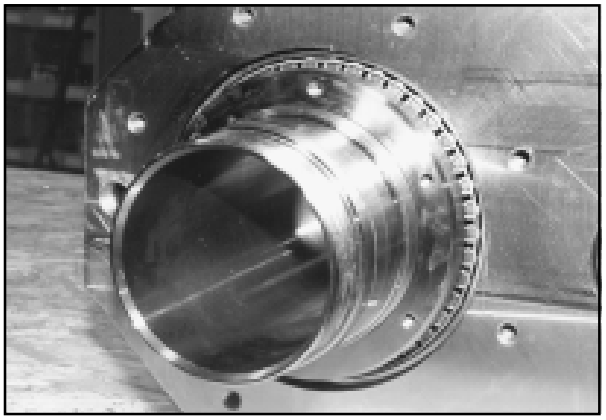




NOTE: It may be required to install a 3/8" UNC x 3/4" bolt in one of the existing bolt holes on the inner lock ring to assist with removal.

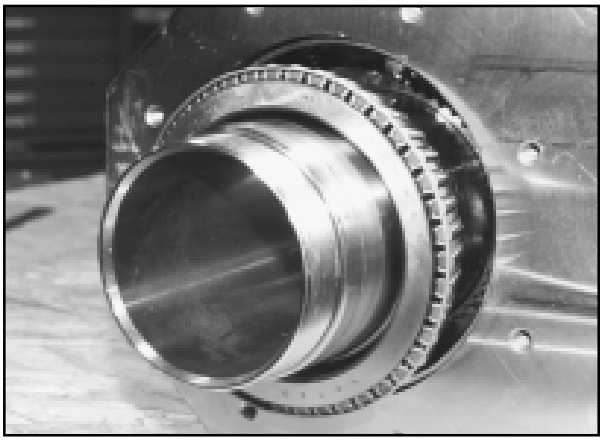
The spindle thread is a right hand thread.

26. Remove inner lock ring from the spindle.



NOTE: If problems persist in the removal of this cone bearing, you may want to leave it on. It will drop off the spindle by itself during removal of the main housing cover.

27. Remove the bottom cone bearing from spindle.

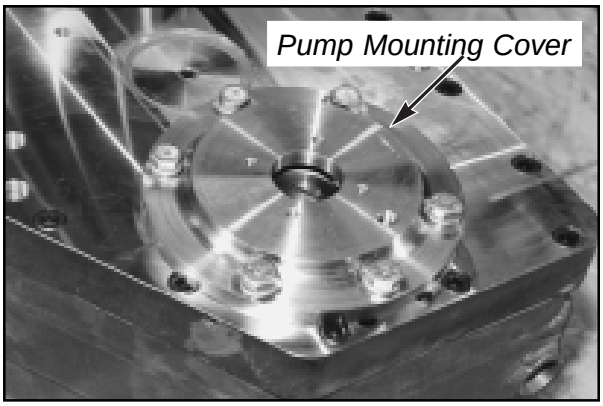


NOTE: Blocks must not interfere with the removal of the spindle.

28. If the bearing is removed at this time, remove the large snap ring from the spindle. This is the snap ring that holds the output gear in place.

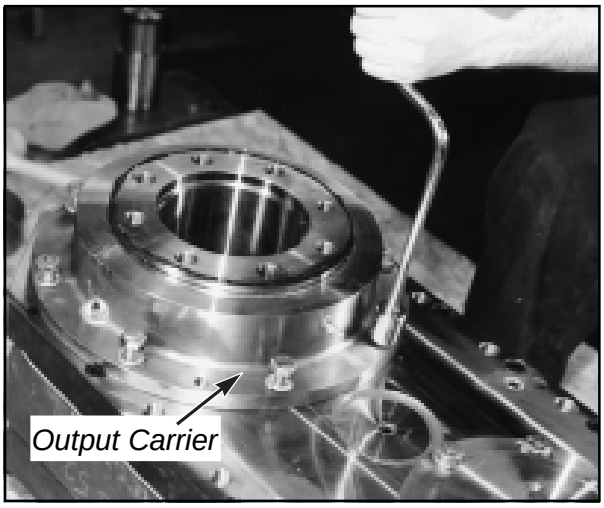
29. Using the appropriate lifting devices, lift the PQ head and rotate it so spindle is vertical to the work bench. Lower PQ head down on blocks so that it is approximately 8” (200 mm) above the work bench.

30. Remove the six 1/2” UNC bolts and lock washers from the pump mounting cover.



NOTE: The silicone seal must be broke free first.

31. Remove the pump mounting cover.
32. Remove the 1/2” UNC bolts and lock washers from the output carrier.

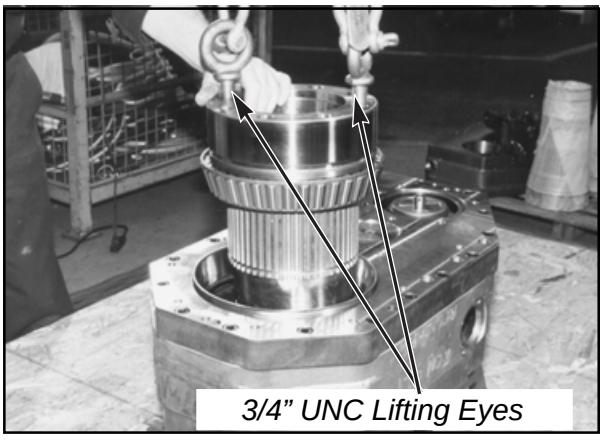


NOTE: The silicone seal must be broke free first.

33. Remove the output carrier.

34. Place the output carrier face down on the work bench. Using a punch, drive the two oil seals out of the output carrier bore.

35. If the large snap ring is removed from the spindle, the spindle can now be removed.



NOTE: Caution is advised so as not to damage the threads on the spindle.

36. To remove the spindle, insert two 3/4" UNC lifting eyes into the 3/4" UNC tapped holes in the chuck adapter flange. Connect a chain or sling and utilizing an overhead hoist to lift the spindle up and out of the PQ head.

NOTE: It is recommended that a punch made of a soft material be used, preferably brass.

37. With the threaded end of the spindle resting on the work bench, drive the output wear sleeve down and off the chuck adapter flange portion of the spindle.

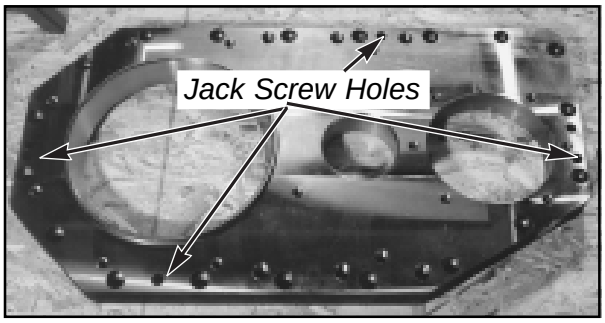
38. Now drive off the top cone bearing with the same punch.

NOTE: During the removal of the wear sleeves, be careful to avoid damaging the spindle O.D.

39. Turn the spindle over so that the chuck adapter flange is resting on the work bench. Remove the two wear sleeves.

40. Remove the eighteen 1/2” UNC x 1-3/4” capsrews.

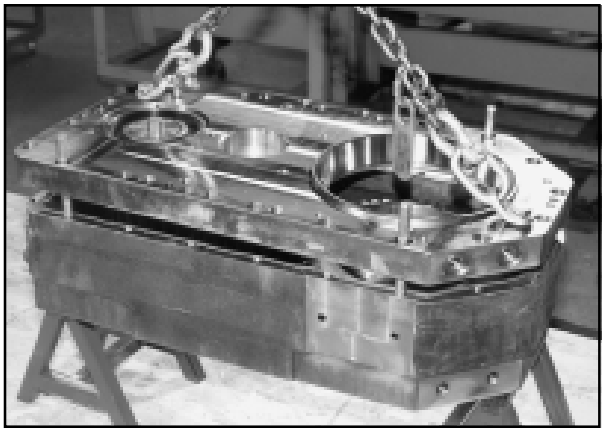
41. Locate and remove the four 1/2” UNC x 3/4” setscrews. These locations are the four jack screw locations.



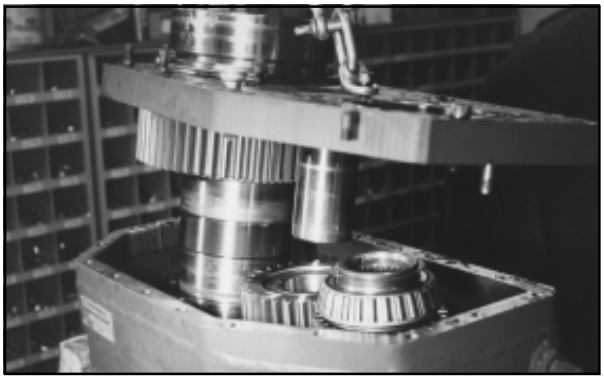
42. Install four 1/2” UNC bolts with approximately 2” (50 mm) of thread length.

43. Begin removal of the housing cap by tightening the jack screw bolts in a cross hatch pattern.

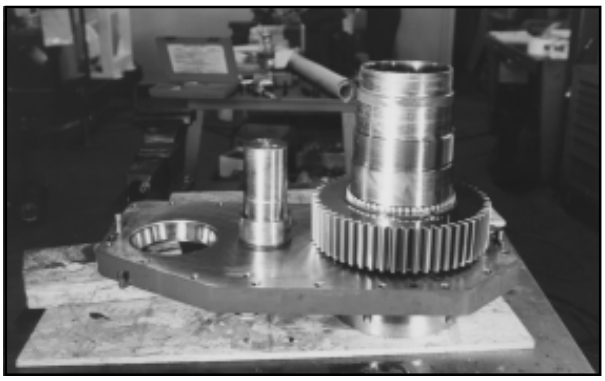
44. When the housing cover has broke lose from the main housing by approx. 1/2”, install a proper lifting arrangement so as to lift the housing cover off the main housing as level as possible.



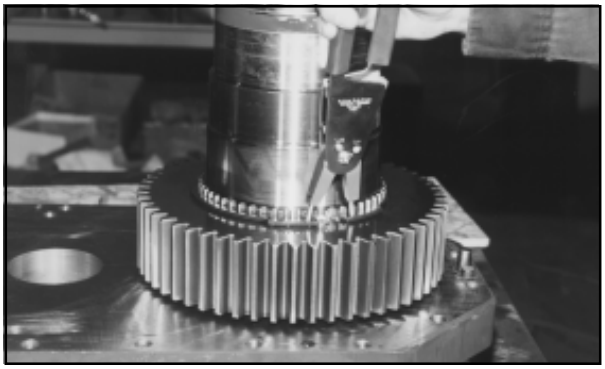
45. If the lower spindle cone bearing was left on the spindle, it will now drop off and onto the work bench. The spindle, output gear and the intermediate idle shaft and gear assembly will also be removed with the main housing cover.

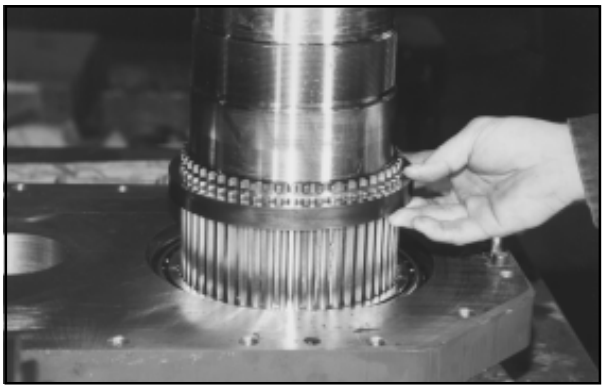


46. Lay the main housing cover down flat on the work bench with the output gear exposed.



47. Remove the larger spindle snap ring, spacer and output gear.





48. Raise the cover up and off of the main spindle.

49. The intermediate idle shaft and gear assembly can be removed with a soft punch or set up in a press and pressed out of the intermediate shaft.

50. Turn the cover upside down and blocked up approximately 2” (50 mm) above the work bench.

51. Drive out the two remaining bearing races.

52. Slide the intermediate spacer off the intermediate idler shaft.

53. Slide the intermediate gear assembly off the intermediate idler shaft.

54. Remove the two intermediate idler shaft cone bearings.
55. Remove the cone bearing spacer.
56. Drive the bearing race down and off of the intermediate gear with a punch.
57. Remove the bearing race spacer.
58. Drive the second bearing race off of the intermediate gear with a punch.
59. Lift out the input pinion and shaft from the main housing. Place it input side down on the work bench.

60. Remove the snap ring.

61. Drive out the 1/4” (6.4 mm) x 3-1/4 (83 mm) dowel pin.

62. Remove the pump adapter tang.

63. Remove the pump adapter.

64. Remove the two input pinion and shaft cone bearings using appropriate bearing pullers.

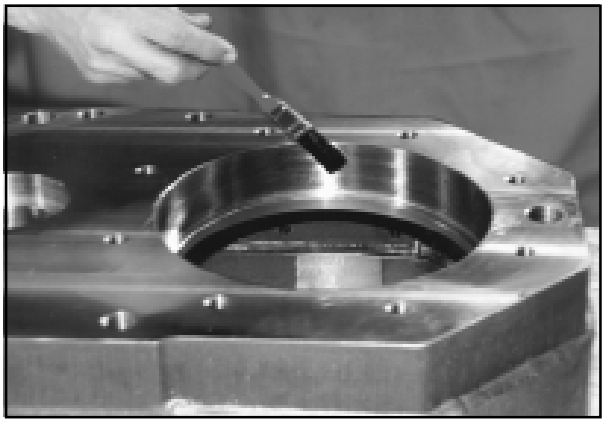
PQ Head Reassembly Procedures

NOTE: It is recommended that the PQ Head be serviced in a shop environment with the aid of an overhead lifting device and appropriate shop tools.

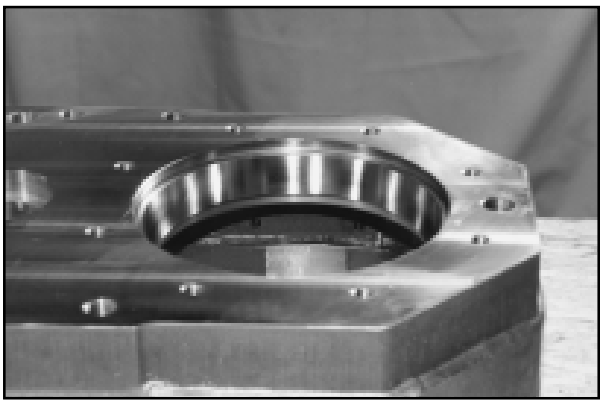
CAUTION **All PQ Head internal parts must be free and clean of any foreign matter. Extreme caution is advised in the handling and assembly of the PQ Head due to the size and weight of parts. Watch for pinch points during the disassembly and reassembly procedure. All parts must be cleaned and free of dirt, burrs and RTV sealant. All threaded holes must be cleaned of locktite and RTV sealant using the appropriate size taps. Take care to ensure that all internal oil galleries are clean and unclogged.**

1. Place the main housing, bottom end facing up, on a solid work bench.

2. Apply a film of oil on the bore diameter before installation.

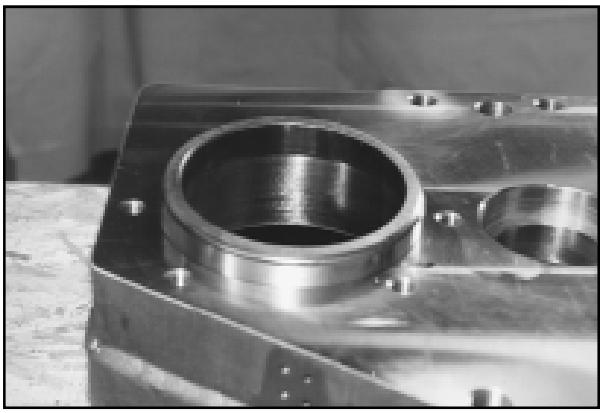


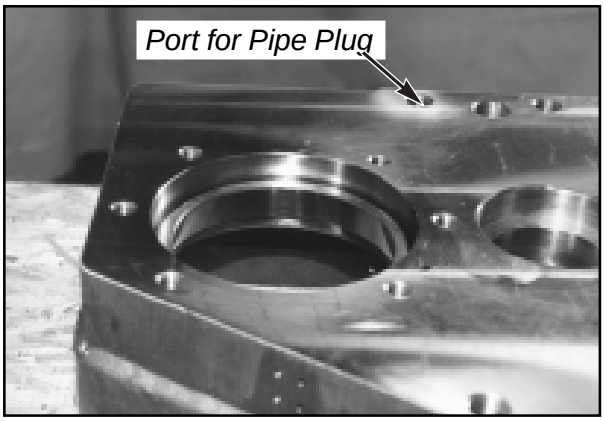
Install the bottom spindle bearing race using an appropriate driver. Make sure race is pressed tight against bottom of counter bore.



3. Apply a thin film of oil on outside diameter of bearing race before installation. Install bottom bearing input shaft race using appropriate driver.

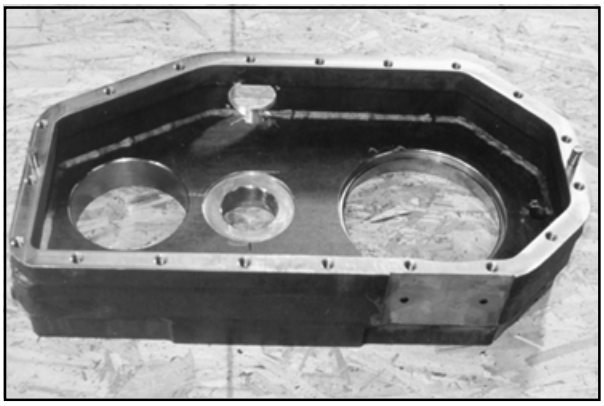
NOTE: Notice the direction of race installation to accommodate input shaft bearing. Install race approx. 1/4" (0.64 cm) into the bore.



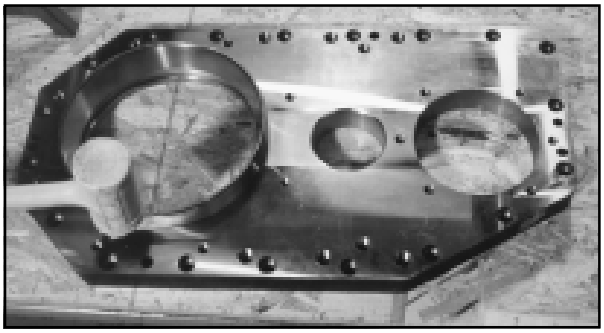


4. **NOTE:** Clean and re-install magnetic pipe plug using an appropriate pipe thread sealant.

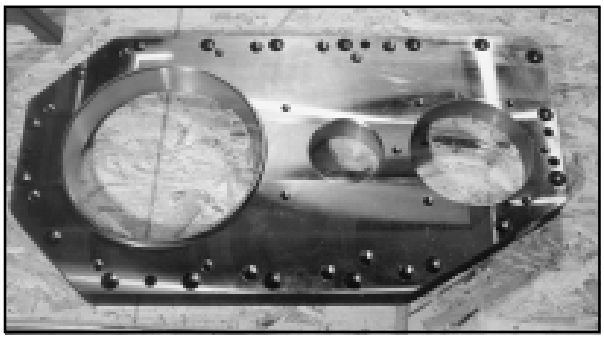
5. Turn main housing over, face-up. Check dowel pins for signs of wear or burrs.



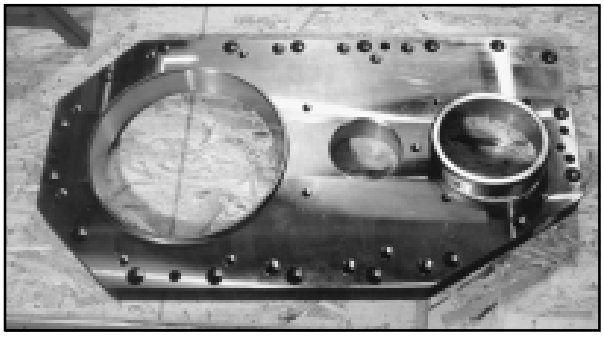
6. Place housing cover face-up. Apply a film of oil on bore diameter before installation. Install top spindle bearing race using an appropriate driver.

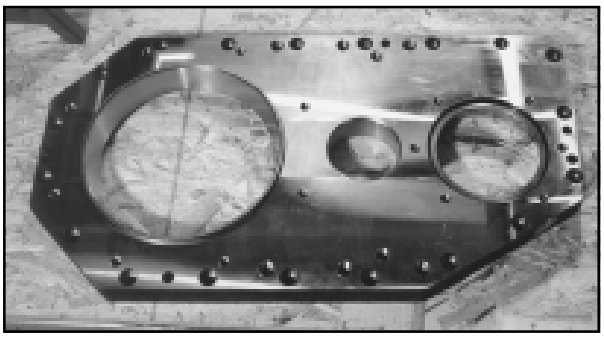


Ensure that bearing race is seated firmly at bottom of counter bore.



Apply a film of oil on bore diameter before installation. Install top input shaft bearing race into bore approximately 1/4” deep.





Install the two 3/8” NPT pipe plugs using an appropriate pipe thread sealant.

Intermediate Gear Assembly

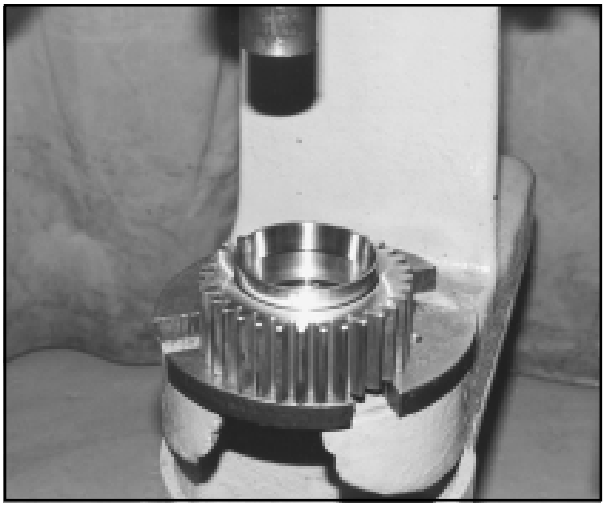
7. Install snap ring into snap ring groove in gear.

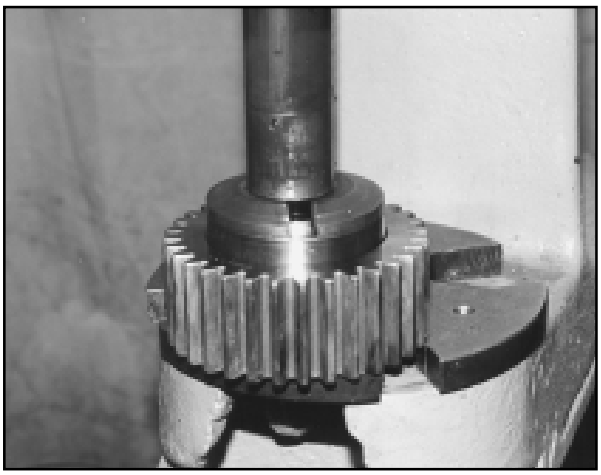
8. Install bearing race spacer into gear.

NOTE: This spacer must be installed in the proper direction. The measurement out to end of gear must be approximately 1-5/16" (3.33 cm) both sides.

Press bearing races in, one on each side of snap ring.

NOTE: Note the orientation of races. When the races are pressed in, they must be tight on spacer.





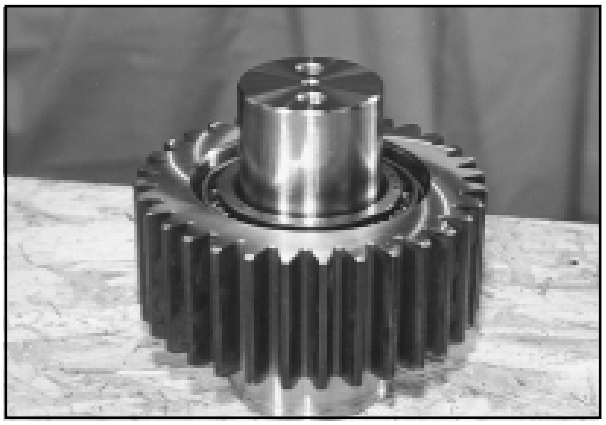
9. Place intermediate gear shaft on work bench. Large diameter down.

Slide intermediate shaft tapered roller bearing down the shaft till it bottoms out. Note the orientation of the bearing.

Install intermediate gear on shaft.

Install bearing spacer.

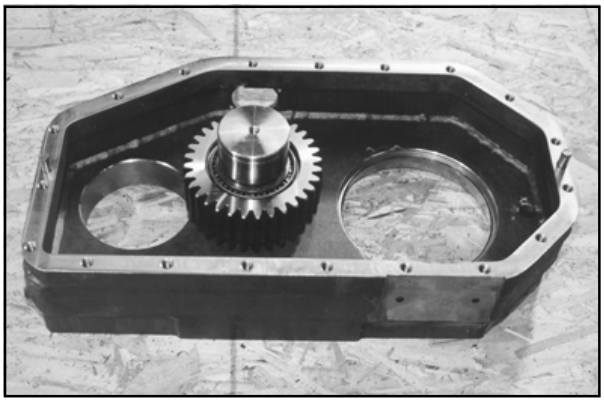
Slide intermediate shaft tapered roller bearing down the shaft and into the intermediate gear.



Install the intermediate spacer.

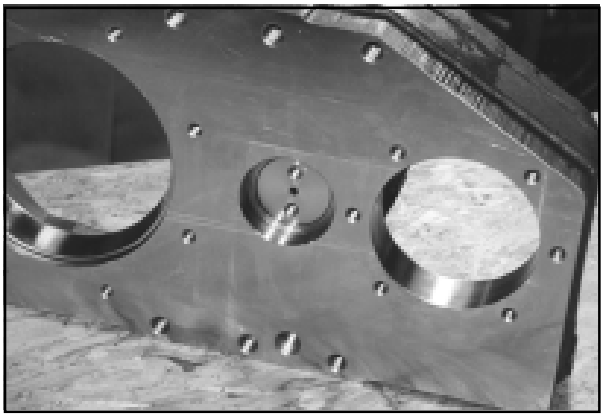
Intermediate Shaft and Gear Assembly

10. With the PQ Head main housing resting flat on the work bench, place the intermediate shaft and gear assembly into the bore. Using a soft-face hammer, gently tap the intermediate shaft and gear assembly in the housing bore. Ensure that the intermediate shaft and gear assembly is square in the bore.

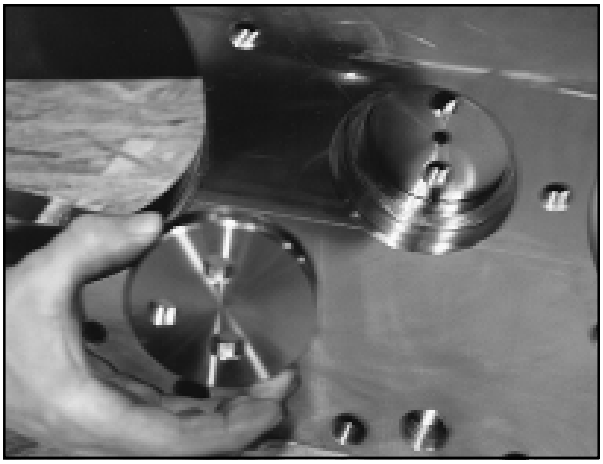


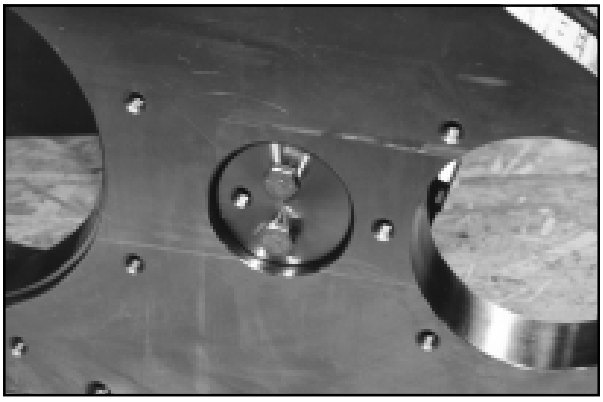
Using a proper lifting sling, roll the main housing on its side, so as to have access to the bottom bore.

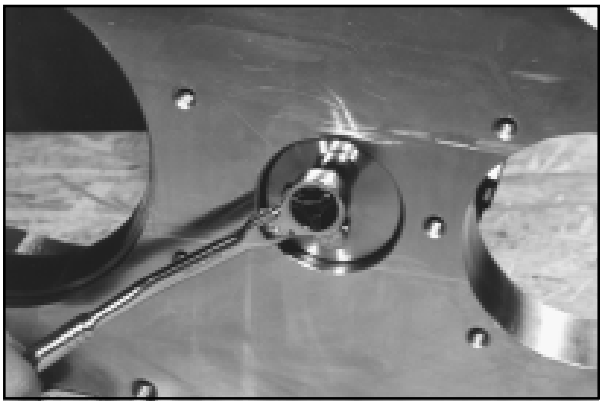
NOTE: Take note of the orientation of the two 1/2" (1.27 cm) UNC threaded holes, they must be at right angles to the main housing.



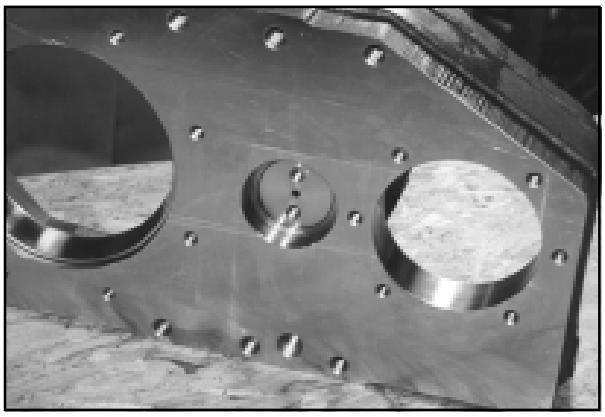
11. Use the intermediate lock plate and two 1/2” UNC bolts of the appropriate length to draw the intermediate shaft into place in the main housing. Tighten each bolt alternately, being careful not to bottom out the bolts in the thread holes.



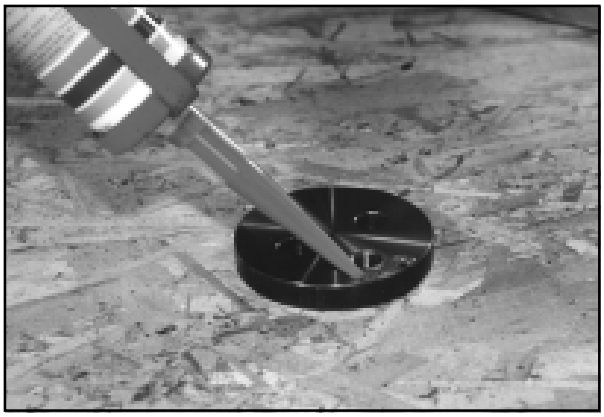




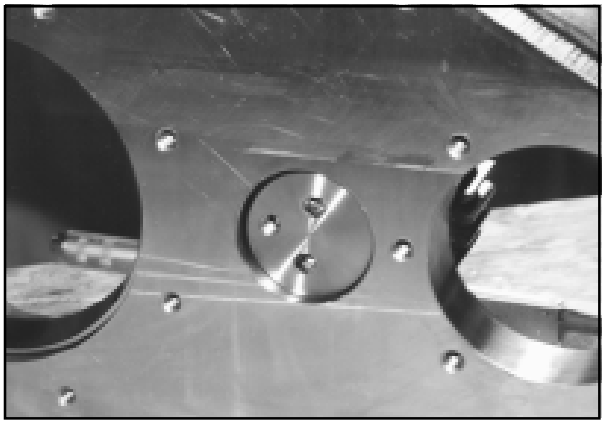
12. When intermediate shaft is drawn into position, remove the intermediate lock plate. There must a gap of approximately .060” (1.5 mm) from end of the intermediate shaft and the bottom of the counter bore.



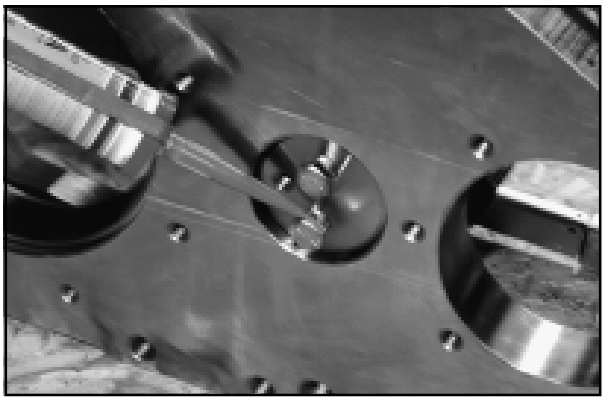
13. Apply RTV high temp silicone to the outer edge of the intermediate lock plate.

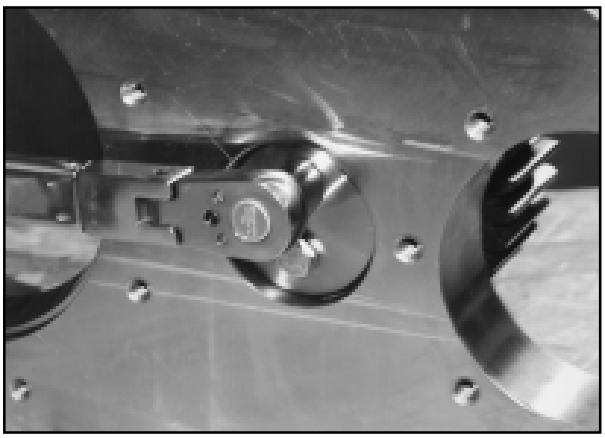


Install lock plate with the 1/4” NPT thread hole on your left hand side. Apply Locktite 242 to the threads of the two 1/2” UNC x 1-1/2” bolts.



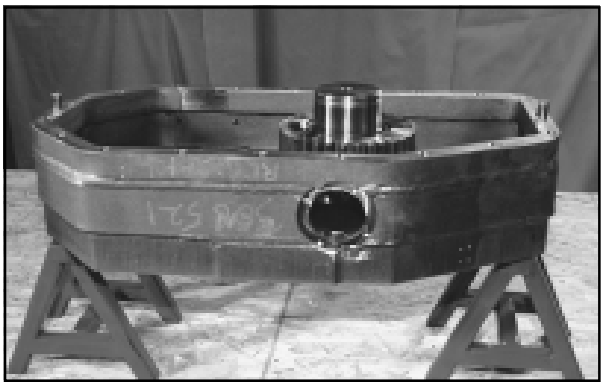
Install bolts part way, then apply RTV high temp sealant to the bolt heads, to seal the bolt holes in the intermediate lock plate. Torque these bolts to 50 lbf•ft (67.79 Nm).



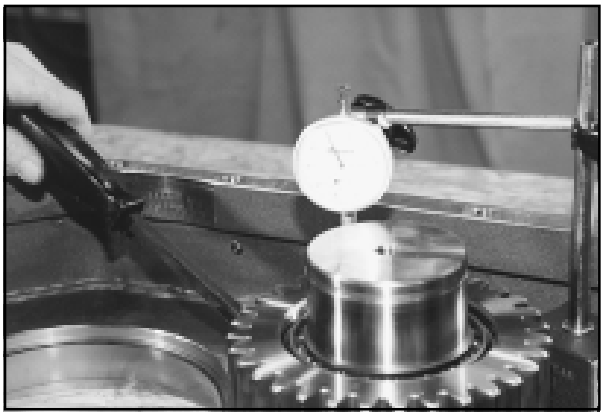


NOTE: Main housing must be blocked up in a way that is very rigid due to the weight and amount of force that must be applied to complete the assembly.

14. Roll the main housing face up on the work bench. Raise and block up the main housing approximately 8” (200 mm) off of work bench. Make sure not to block the main spindle bore or the input shaft bore. These bores must be left open to accommodate the installation of the main spindle and the input gear shaft assembly.



Install a dial indicator inside the main housing. Position the dial point on the face of the intermediate gear. Using a short pinch bar, check for bearing end play of the intermediate gear assembly. It must be between 0.002” to 0.004” (0.051 mm to 0.102 mm).

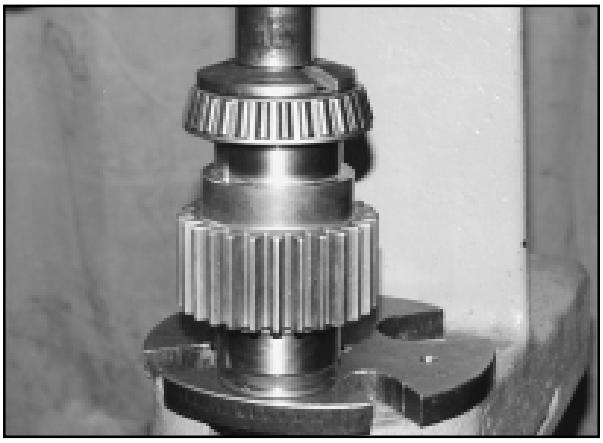


In the absence of a dial indicator the following method can be used as a coarse means of determining end play: Place the appropriate size feeler gauge 0.003” to 0.005” (0.076 mm to 0.127 mm), down inside the bearing and resting on top of the race (roller contact surface). Rotate the bearing. The bearing rollers should roll over the proper feeler gauge size and should not roll over a feeler gauge size greater than 0.005” (0.127 mm).

Input Pinion and Shaft Assembly

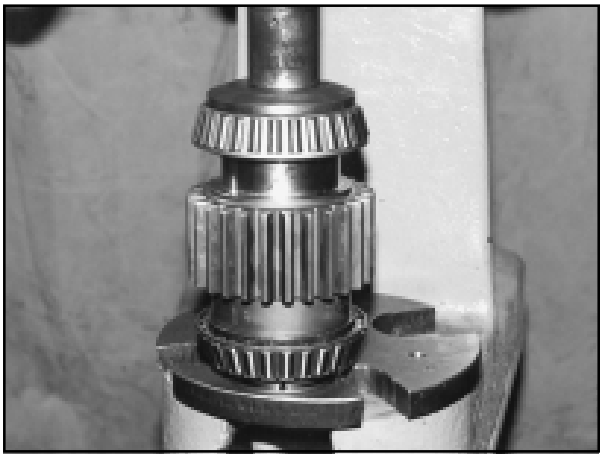
NOTE: The correct orientation of the tapered roller bearing. Make sure the bearing bottoms out on the shaft.

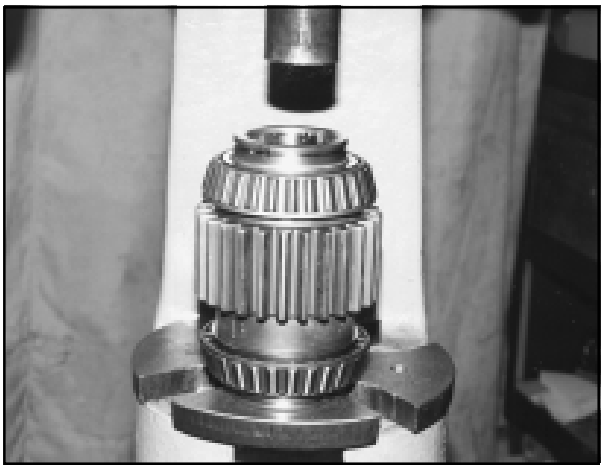
15. Using an appropriate driver and press, press the tapered roller bearing onto the input pinion and shaft.



NOTE: The “cover” side of the input pinion and shaft is the end of the shaft that is shortest to the gear face. The “main housing” side of the input pinion and shaft is the end of the shaft that is furthest from the gear face

Install the 2nd bearing in the same manner.





16. Install the pump adapter into the bore of the input pinion and shaft. Line up the matching holes.

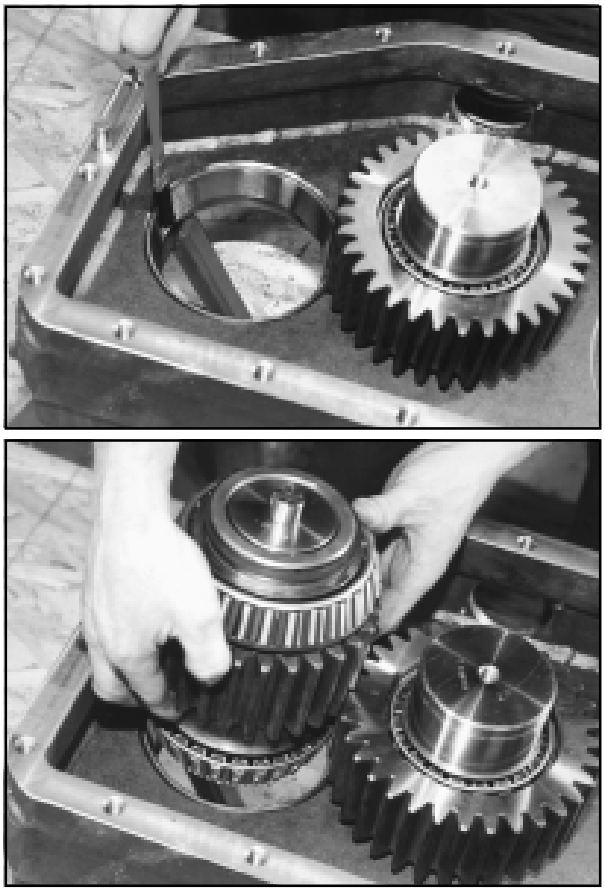
Install the pump adaptor drive tang. Push the 1/4” (6.4 mm) diameter dowel all the way through the input pinion and shaft, pump adaptor and pump adapter drive tang.

Install the snap ring in the snap ring groove.

NOTE: Make sure that the pump adapter tang is in the vertical position.

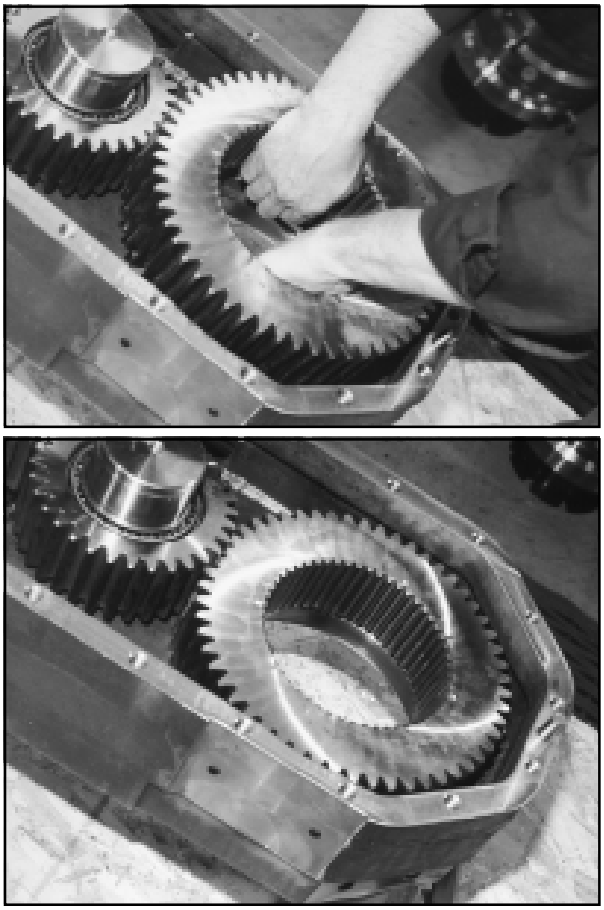
17. Coat the input pinion and shaft bearing race, (in the main housing) with a thin film of oil. Install the input pinion and shaft into the main housing, meshing the pinion with the intermediate gear.

CAUTION Pinch-point condition in this part of the assembly.

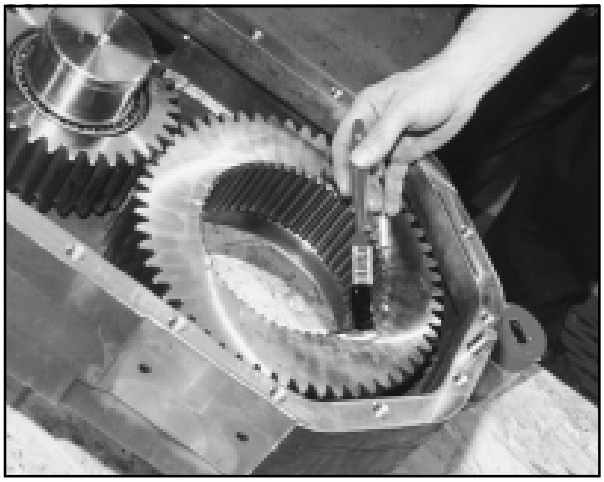


CAUTION **Pinch-point condition in this part of the assembly.**

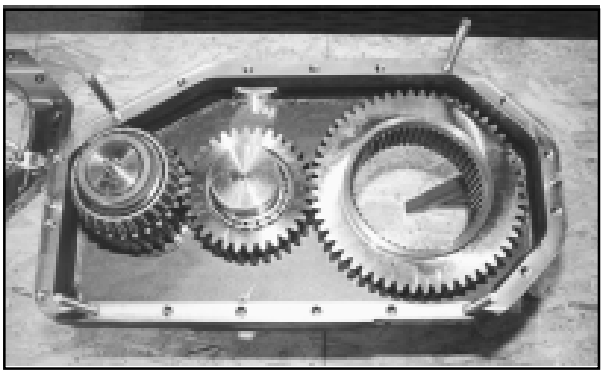
18. Install the output gear inside the main housing while meshing with the intermediate gear.



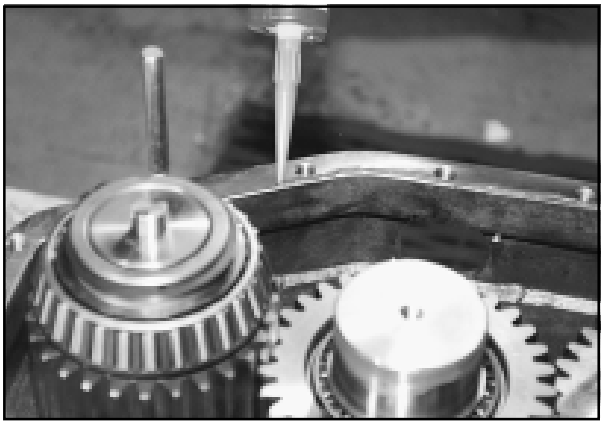
Coat the face and the internal spline of the gear with a thin film of oil. Place the output spacer on top of the spindle gear, centering it on the bore diameter.



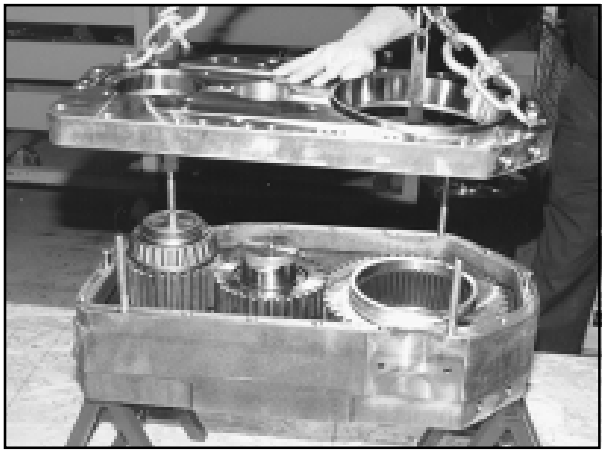
19. Install four 1/2” x 5” UNC bolts (remove the heads), one in each corner of the main housing. These will act as line-up pins for the installation of the housing cover.



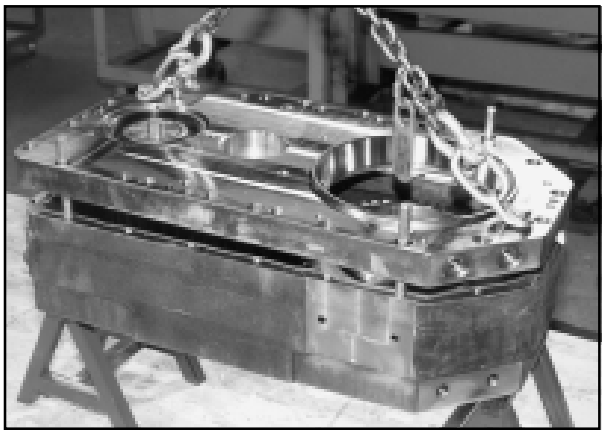
20. Spread a coating of RTV high temp sealant in the groove in the top of the intermediate shaft. Run a bead of RTV high temp sealant on the face of the main housing, inside the bolt pattern.



21. Using an appropriate sling or chain method, sling the housing cover in such a manner that it can be lifted vertically, while being balanced and level.

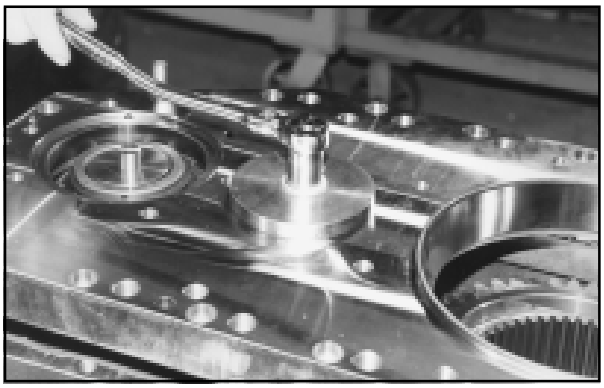


22. Lower the housing cover onto the four line up pins, letting the cover down slowly so as to rest square and level on the top of the intermediate shaft.



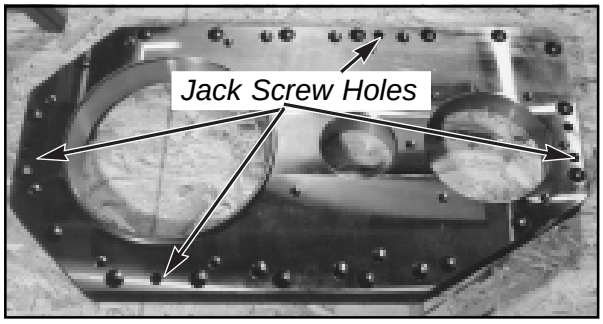
CAUTION **The cap must be drawn down evenly or it will gall the intermediate shaft. 1/2" UNC bolts of the appropriate length can be inserted into the housing cover bolt holes in order to assist with this operation. Care must be taken as not to bottom out the bolts in the thread holes which would damage the threaded holes of the main housing. Once the housing cover has seated firmly to the main housing, remove all bolts, line up pins and the washer or bar from the intermediate shaft.**

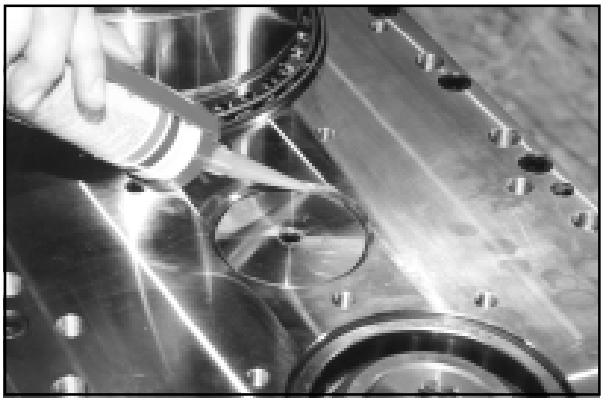
23. Using a suitable washer or bar and appropriate 1/2" UNC bolt, draw the cap down evenly to the face of the main housing.



24. Coat the beginning of the thread on all 18-1/2” UNC x 1-3/4” capsrews with RTV high heat sealant. Install the capscrews and torque to 50 ft lbs in a cross-hatch pattern.

NOTE: Run a bead of RTV high heat sealant between the top edge of the intermediate idle shaft and the mating bore chamfer of the main housing cover.



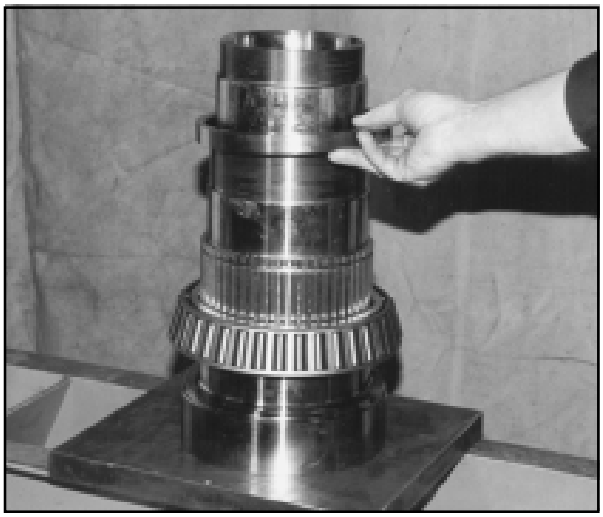


25. Install the five 1/2” UNC x 3/4” set screws. One in each of the four jack screw locations and one in the center of the intermediate shaft. This will protect the threads of the holes for removal of the housing cover.

Output Shaft Assembly (Spindle)

26. Place the spindle in a press. Apply a film of oil on the spindle bearing shoulder. Assemble the top tapered bearing cone onto the spindle with the large bearing O.D. towards the chuck flange on the spindle.

Place the output spacer over the spindle and on top of the bearing.



Now place the output gear onto the spindle, as the gear will only be used to press the top bearing cone into position against the chuck adaptor flange and then removed.

Position a suitable piece of hollow tubing over the threaded section of the spindle onto the output gear.

Press the top bearing into position against the chuck adaptor flange.

27. Place the spindle with the threaded section resting on the work bench and the bearing up.

NOTE: Use a suitable material under the threaded end of the spindle so as to protect the threads. Coat the top end of the spindle with a thin film of oil.

Install the output wear sleeve on top of the spindle.

Tap the output wear sleeve down the spindle chuck adaptor flange so that it is approximately 0.030” (0.76 mm) below the face of the chuck adaptor flange.

28. Turn the spindle so that the chuck adaptor flange is resting on the work bench and the thread end is up. Coat the machined diameter between the two threaded portions of the spindle with a light film of oil.

Place the first wear sleeve, lip down over the first threaded portion of the spindle.

CAUTION **Take care as not to damage spindle threads while installing the wear sleeve.**

Using an appropriate driver, drive the wear sleeve down till it rests on the shoulder of the beginning of the second threaded portion of the spindle.

Place the second wear sleeve, lip up over the first threaded portion of the spindle.

CAUTION **Take care as not to damage spindle threads while installing the wear sleeve.**

Using an appropriate driver, drive the wear sleeve down till it is tight against the first wear sleeve.

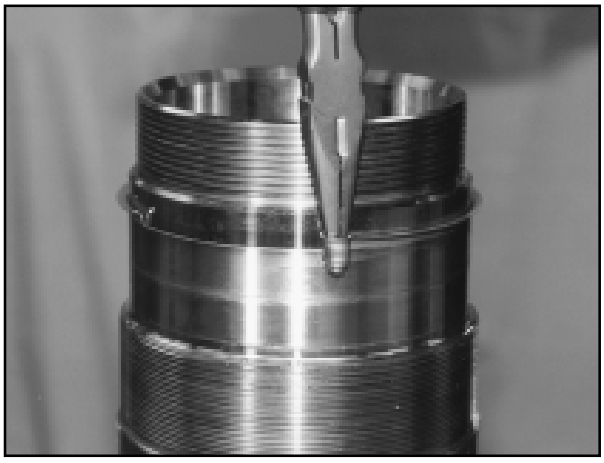
CAUTION **Care must be take to avoid personal injury and external damage to the wear sleeves in this part of the assembly procedure. The re-scoring of the wear sleeves ensures a good clean break of the wear sleeve lip. Any sharp jagged edges will cut the seals of the lower seal carrier upon installation.**

Using a utility knife, re-score the existing score lines of the two wear sleeves.

Using an appropriate tool, cut through the lip of each wear sleeve.

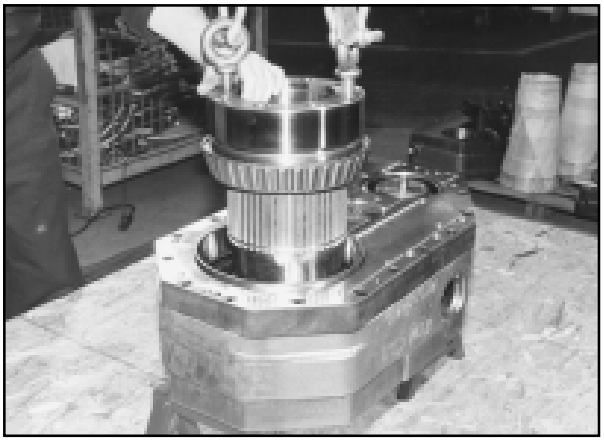
CAUTION **The lip being removed from the wear sleeves is extremely sharp, caution is advised.**

Roll the lip off each wear sleeve by inserting a pair of needle nose pliers into the lip and rolling the severed lip off the wear sleeve and around the needle nose pliers.



29. Turn the completed spindle up so that the threaded end of the spindle is resting on the work bench. Using the 3/4” UNC tapped holes in the spindle chuck adaptor flange, install the appropriate lifting aid. Sling the spindle up and guide it through the main housing being careful not to damage the threaded portions of the spindle. A slight twist of the spindle may be required to line up the spline of the spindle with the internal spline of the output gear. Be sure that the tapered roller

bearing on the spindle is completely seated in the bearing race of the housing cover.



Output Carrier and Pump Mounting

30. Place the output carrier, face down on the work bench. Install the first oil seal lip down. Drive the seal down until it bottoms out on the bottom of the counter bore.

NOTE: Make sure that the oil seal is installed square and not blocking the grease fitting port.

Install the second oil seal, lip up. Drive the oil seal down to a measurement of 1” (25.4 mm).

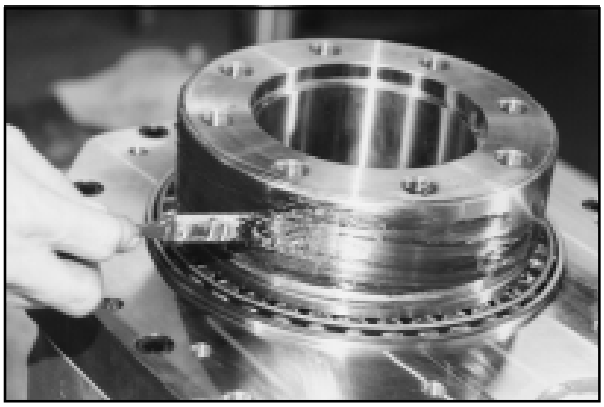
Install the 1/8” NPT grease fitting. It must be installed in the proper hole location so that grease enters between the oil seals and not into the main housing cavity.

Install the 1/8” NPT plug.

Pack the oil seals with a multipurpose EP2 grease.

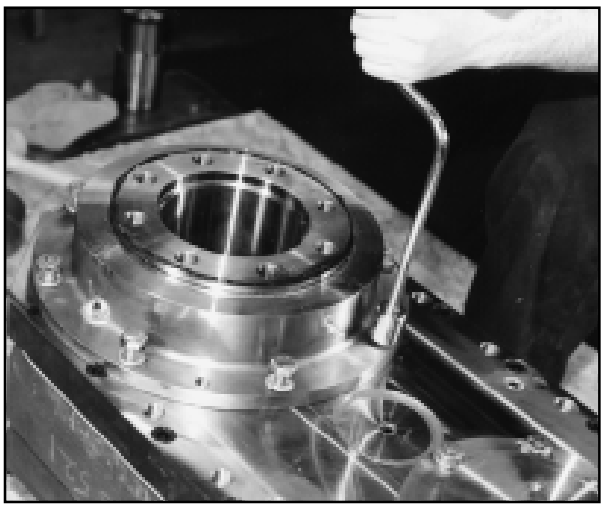
Apply a bead of RTV high heat sealant to the flange area of the output carrier, just inside the bolt circle.

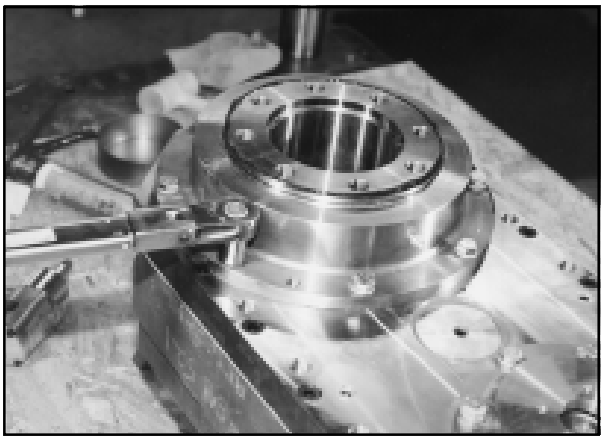
31. Apply a film of grease to the chuck adapter flange on output spindle.



32. Install the output carrier with the 1/4” NPT port to the front of the main housing.

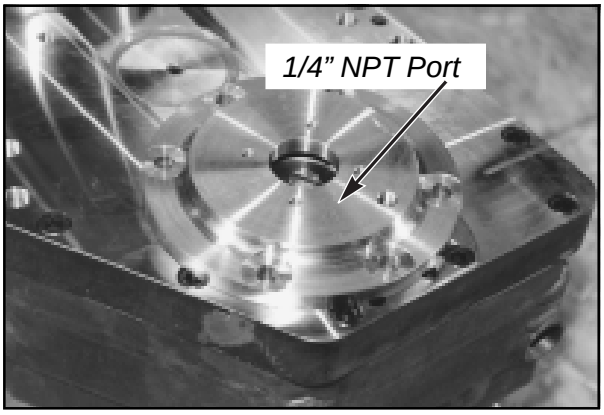
Install the eight 1/2” UNC x 1-1/2” bolts and lockwashers. Torque to 50 lbf•ft (67.79 Nm), using a cross hatch tightening pattern.



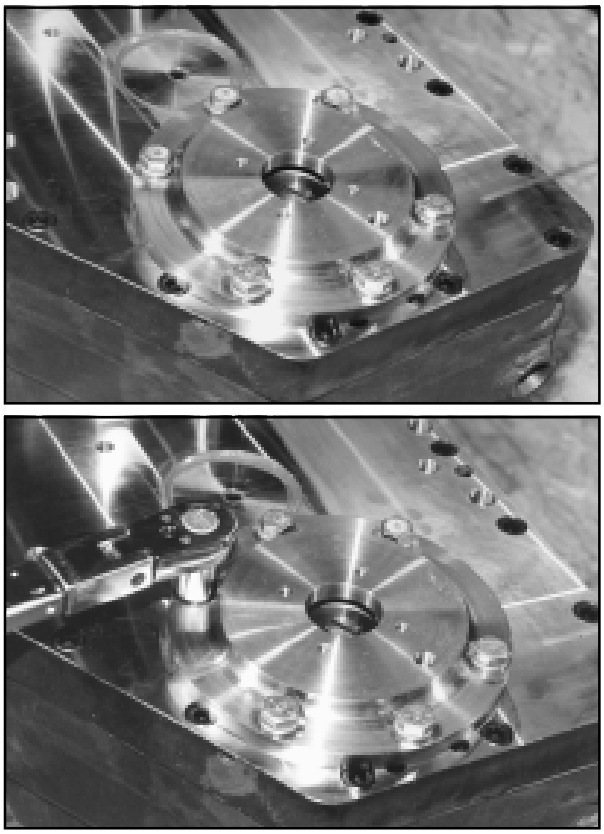


NOTE: The 1/4" (0.64 cm) NPT port must be on your right hand side as viewed from the front of the main housing.

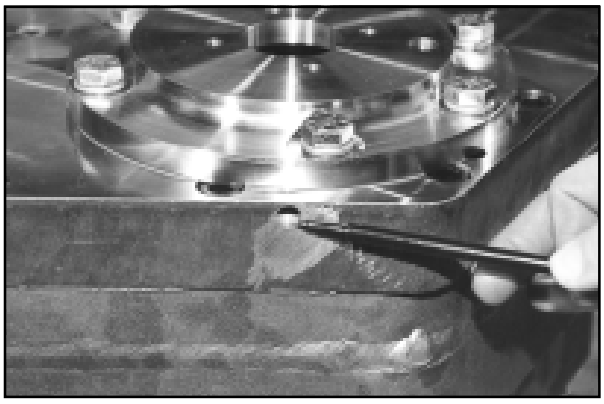
33. Place the pump mounting cover upside down on the work bench. Apply a bead of RTV high heat sealant inside the bolt circle. Install the pump mounting cover.



Install the six 1/2” UNC x 1-1/2” bolts and lockwashers. Torque to 50 lbf•ft (67.79 Nm), using a cross hatch tightening pattern.



Check this oil galley to insure it is free of RTV high temp sealant.



NOTE: That the spindle is horizontal to the work bench.

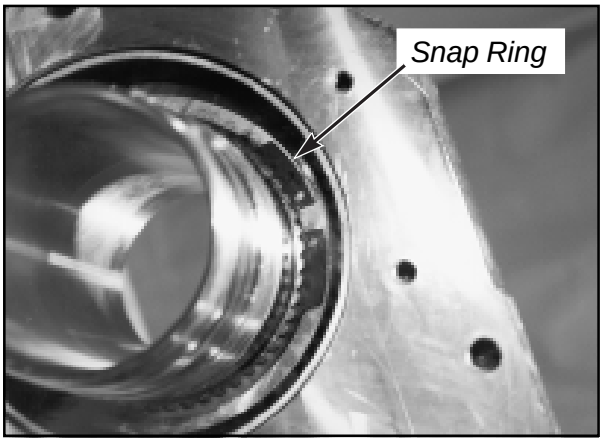
NOTE: Care must be used during this procedure so as not to damage the oil seals in the output carrier. The spindle is not secured in the PQ Head and may be dislodged.

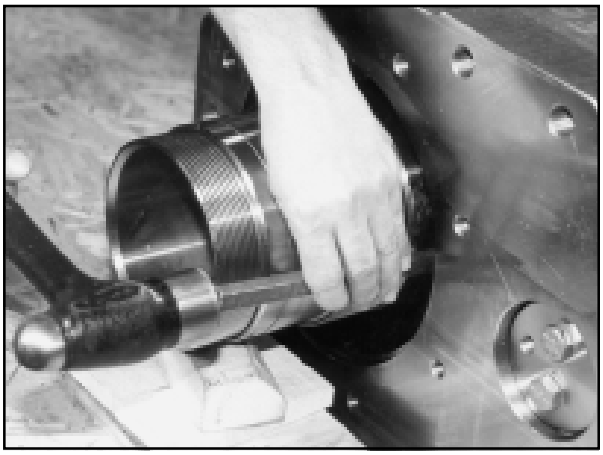
NOTE: The output gear may have to be tapped back tight against the output spacer and spindle bearing.

CAUTION **Avoid oil seal damage and the addition of any debris inside the main housing.**

34. Using the proper lifting devices, lift the PQ Head off the blocking and rest it on the work bench.

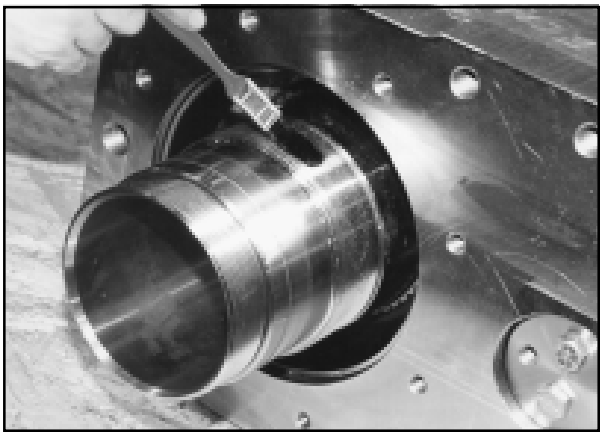
    Install the snap ring in the snap ring grove in the splined portion of the spindle.





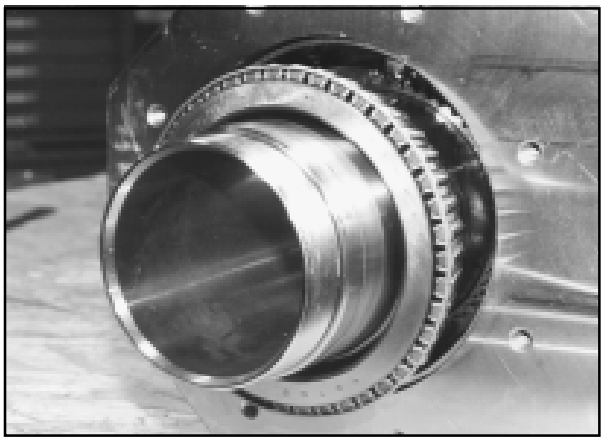
NOTE: Observe correct orientation of the cone bearing.

35. Coat the bottom spindle bearing race and spindle threads with a film of oil. Install the bottom spindle cone bearing.



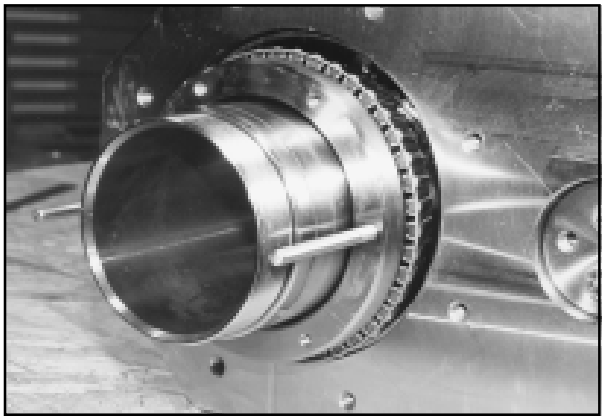
NOTE: By using two 3/8" (0.95 cm) UNC x 5" (12.7 cm) bolts, installed at 180° apart on the inner lock ring bolt circle, the lock ring can be threaded onto the spindle, pressing the cone bearing on the spindle, square and inline.

CAUTION **Should be exercised so as not to damage the threaded section of the output shaft.**

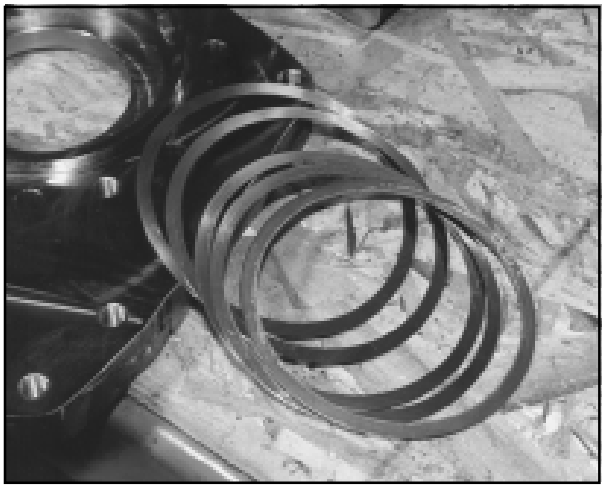


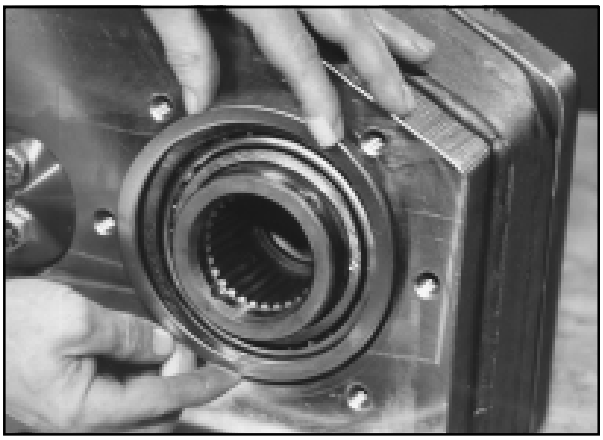
With the aid of the inner lock ring, the cone bearing can be installed on the spindle.

Tighten the inner lock ring until the cone bearing is seated in the bearing race on the main housing.



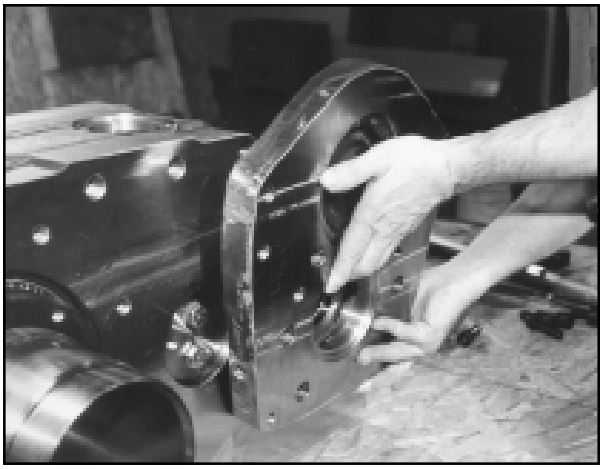
37. Clean and coat the original shim pack, for the input pinion and shaft, with a film of oil. Install the shim pack in the input pinion and shaft bore of the main housing.



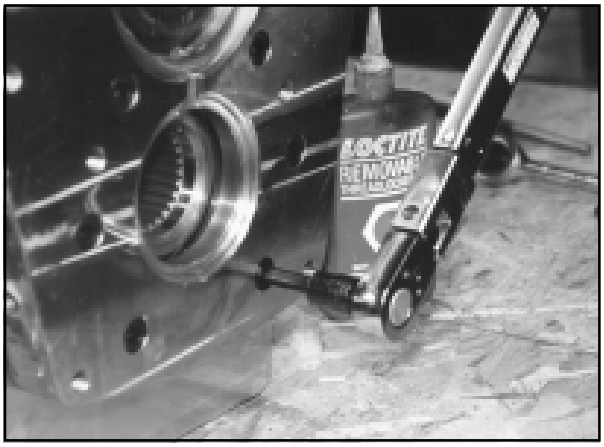


38. Lay the input carrier flat on the work bench, lip up, and apply a bead of RTV high heat sealant around the outside edge lip.

Install the input carrier in the input pinion and shaft bore of the main housing. The correct position of the input carrier is with the large counter bore on top with the input carrier protruding over the front of the main housing.

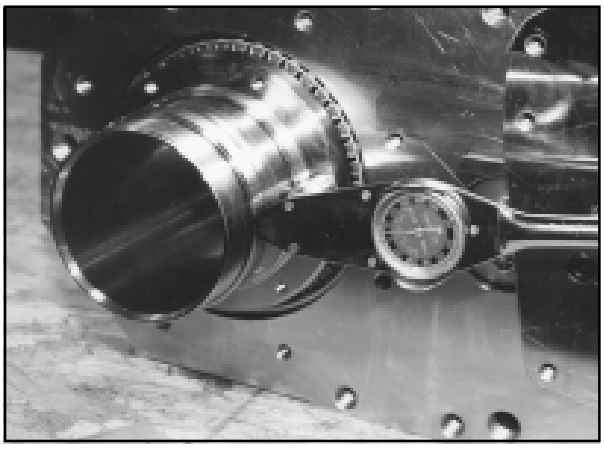


Apply Locktite 242 to the threads of the six 1/2” x 1-3/4” capscrews. Install and torque to 50 lbf•ft (67.79 Nm).



NOTE: The output shaft should be rotated and the inner lock ring tightened alternately several times to ensure that the bearings are indeed seated in the housing and the torque value is maintained.

39. Back off the inner lock ring one turn. Remove the two 3/8” UNC x 5” bolts used for installation of the bearing. Install a 3/8” UNC x 3/4” bolt and flat washer. Torque the inner lock ring to preload the output shaft for a rolling torque of approximately 70 lbf•in (7.91 Nm).



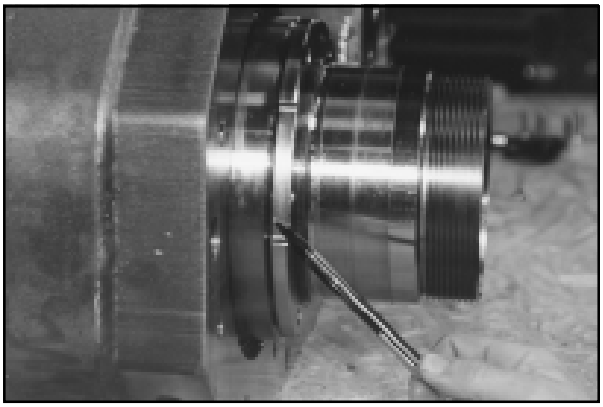
CAUTION **After setting the proper torque and before removing of the 3/8” (0.95 cm) UNC x 3/4” (1.91 cm) bolt, scribe a line on the main housing and inner lock ring.**

Fit the in/lb torque wrench with a 9/16” socket and by utilizing the 3/8” UNC x 3/4” bolt and washer installed previously, thread the inner lock ring up against the bearing to the required torque.

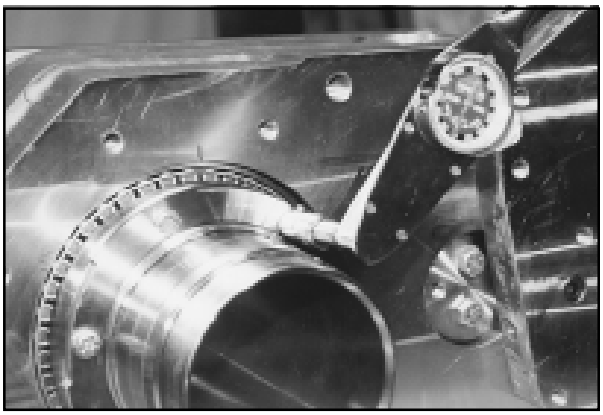
NOTE: Double check your scribe lines to verify that the position of the inner lock ring has not changed.

Remove the 3/8" UNC x 3/4" bolt, being careful not to disturb the position of the inner lock ring.

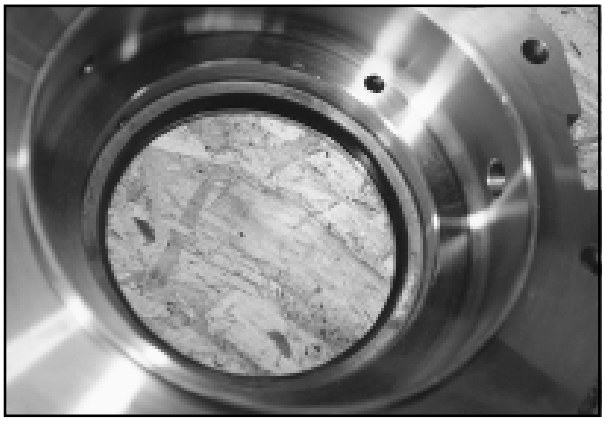
40. Thread on the outer lock ring. Leave a distance of approx. 0.060" (1.5 mm) between the inner and outer lock rings. Position the outer lock ring so that it can be bolted to the inner lock ring.



Apply "Locktite 242" and a 3/8" internal tooth lockwasher to each of the six 3/8" UNC x 1-3/4" bolts. Install the bolts and washers and torque in a cross hatch pattern to 120 lbf•in (7.9 Nm).



41. Place the lower seal carrier face up on the work bench. Place the first oil seal, lip down, into the lower seal carrier. Drive the first oil seal down till it bottoms out on the bottom of the counter bore in the lower seal carrier.



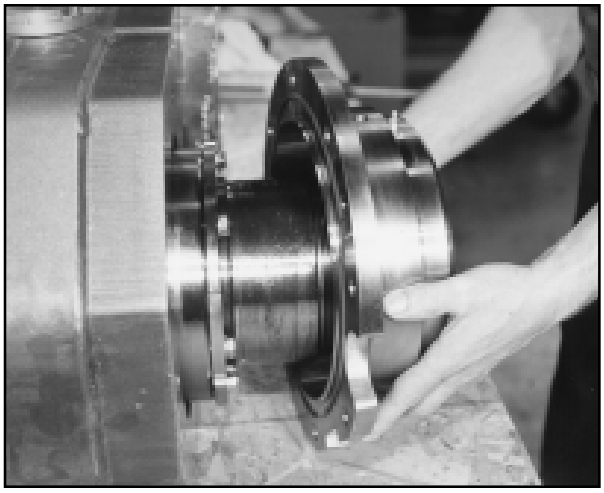
Place the second oil seal, lip up, into the lower seal carrier. Drive the second oil seal down till it is flush with the top of the counter bore in the lower seal carrier.

NOTE: Check the gap between the two seals to ensure that the grease access port is clear.

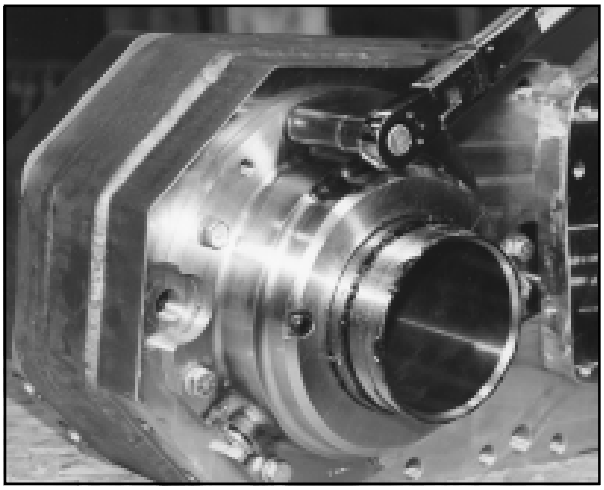
Install the 1/8” NPT grease fitting, #8 ORB plug and the 1/4” NPT plug in the lower seal carrier. Pack the oil seals with a multipurpose EP2 grease.

With the lower seal carrier sitting face up on the work bench, apply a bead of RTV high temp sealant just inside the bolt circle and the lip of the lower seal carrier.

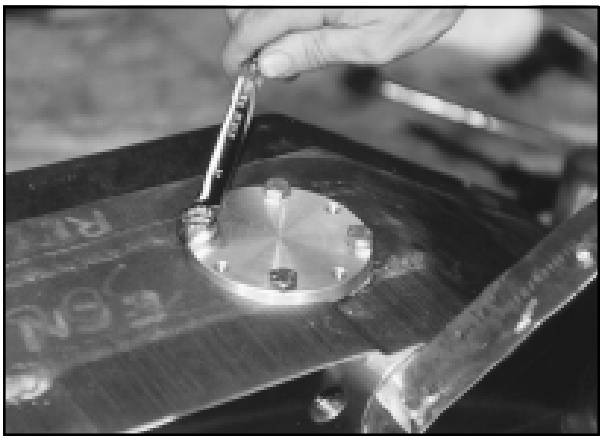
Install the lower seal carrier with the notch in the proper location so as to allow access to the main housing 3/4” NPT return port.



Use eight 1/2” UNC x 1-1/2” bolts and lock washers to fasten the lower seal carrier to the main housing. Torque to 50 lbf•ft (67.79 Nm) in a crosshatch tightening pattern.



42. Put a bead of RTV high temp sealant around the flange of the service cover. Put a bead of RTV high temp sealant around the thread of the four 5/16” UNC x 3/4” bolts. Install the service cover and hand tighten bolts.

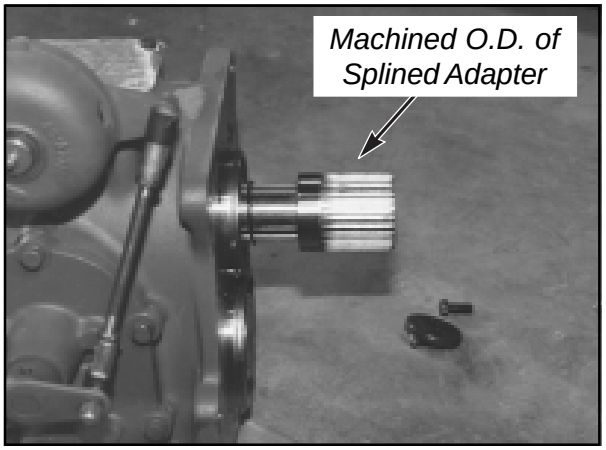


43. Coat the remaining spindle thread with a film of multipurpose (EP2) grease and then install the spindle nut. Four 3/8” UNC x 3/4” capscrews are used in the spindle nut to secure desired spindle bushing.

Transmission Assembly

44. Position the transmission, machined surface down and output shaft facing horizontal on the work bench.

45. Slide the splined adapter on to the spline of the output shaft with the machined O.D of the splined adaptor against the transmission output shaft bearing.



Install the shim pack and retaining washer with the two 7/16” UNF x 1-1/2” bolts to the end of the transmission output shaft. Torque these two bolts to 40 lbf•ft (54.23 Nm).

Using feeler gauges check the distance between the end of the splined adapter and the retaining washer. There must be .005” to .010” (0.013 to 0.025 cm) end play. Lockwire these two bolts together.

46. Apply a Lithium based grease to the splined adapter and the internal spline of the input pinion and shaft. Apply a bead of RTV high heat sealant to the mounting face of the transmission, just inside the bolt hole mounting pattern.

CAUTION **Do not force the transmission into place. Line the transmission and main housing up, and gently rock the transmission until it slides into place freely.**

47. Using a suitable sling and lifting device mount transmission to the input carrier.

Apply “Locktite 242” to the threads of the six 1/2” UNC x 1-3/4” bolts. Install with lock washers and torque to 50 lbf•ft (67.79 Nm).

Hydraulic Module

This module contains the hydraulic pumps, valves, reservoir, hydraulic hoses, function controls, filters and gauges. The reservoir is constructed from aluminium to prevent internal corrosion and features 100 mesh suction strainers on each pump inlet. These are fitted with 3 psi (20 kPa) vacuum bypass valves which will allow full oil flow access to the pumps in case the strainers become blocked or when starting up in sub zero temperatures (32°F - 0°C).

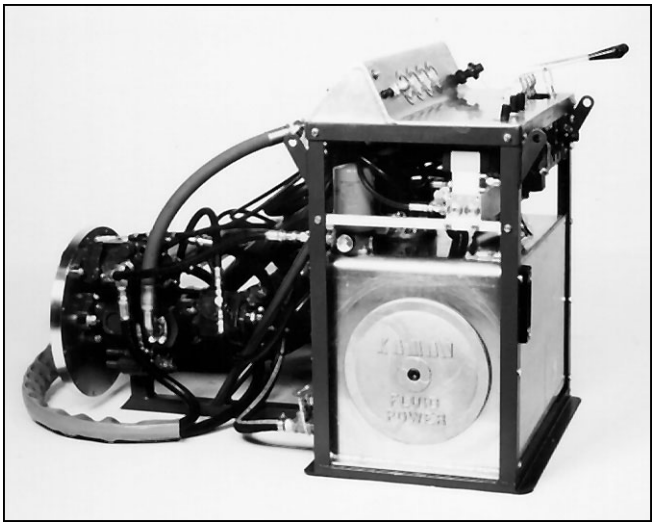
Weight

Complete with hoses, wet (including hydraulic oil).

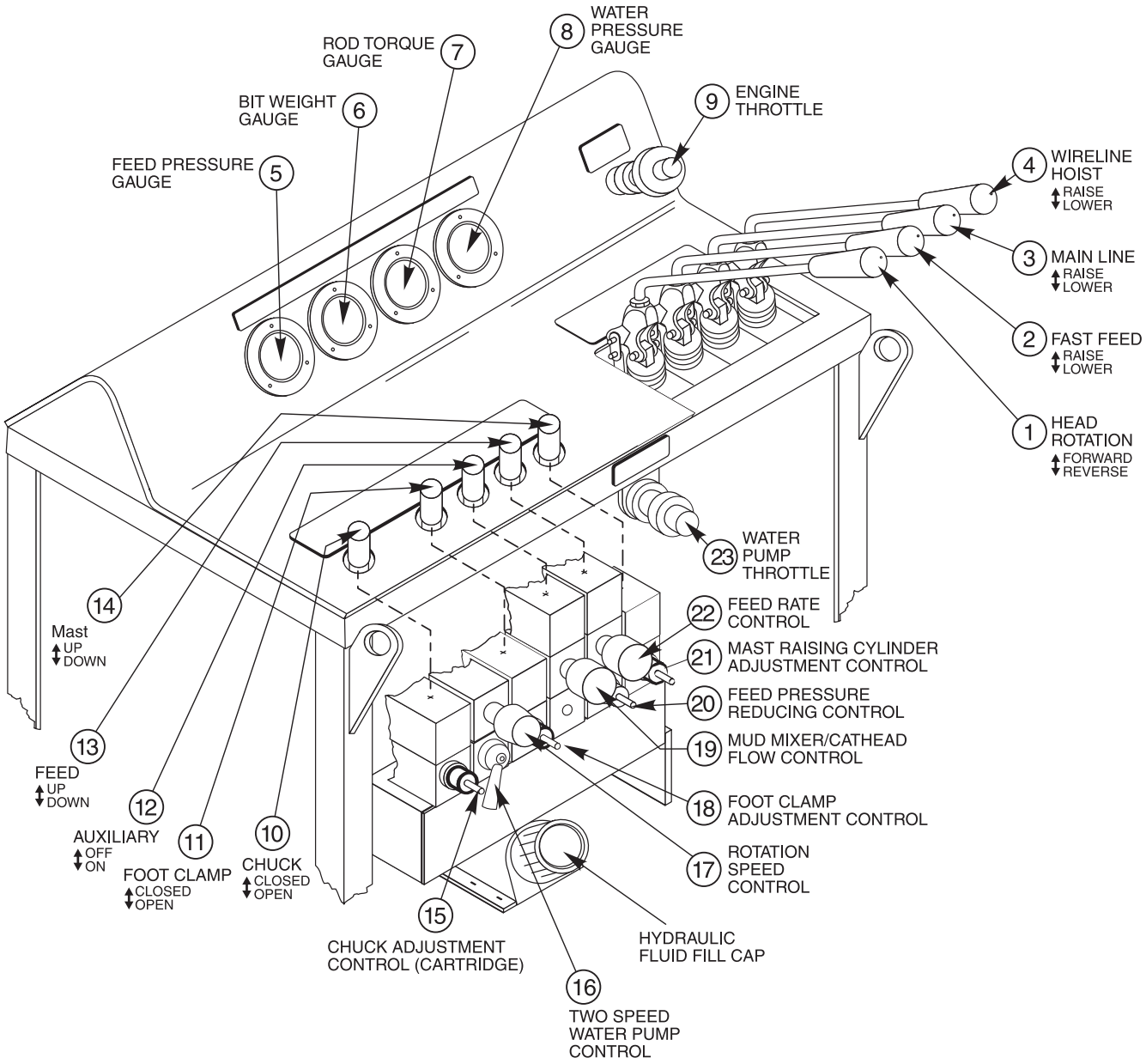
920 lbs 417 kgs

Oil Volume (operating level)

30 U.S. Gallon 114 Litres



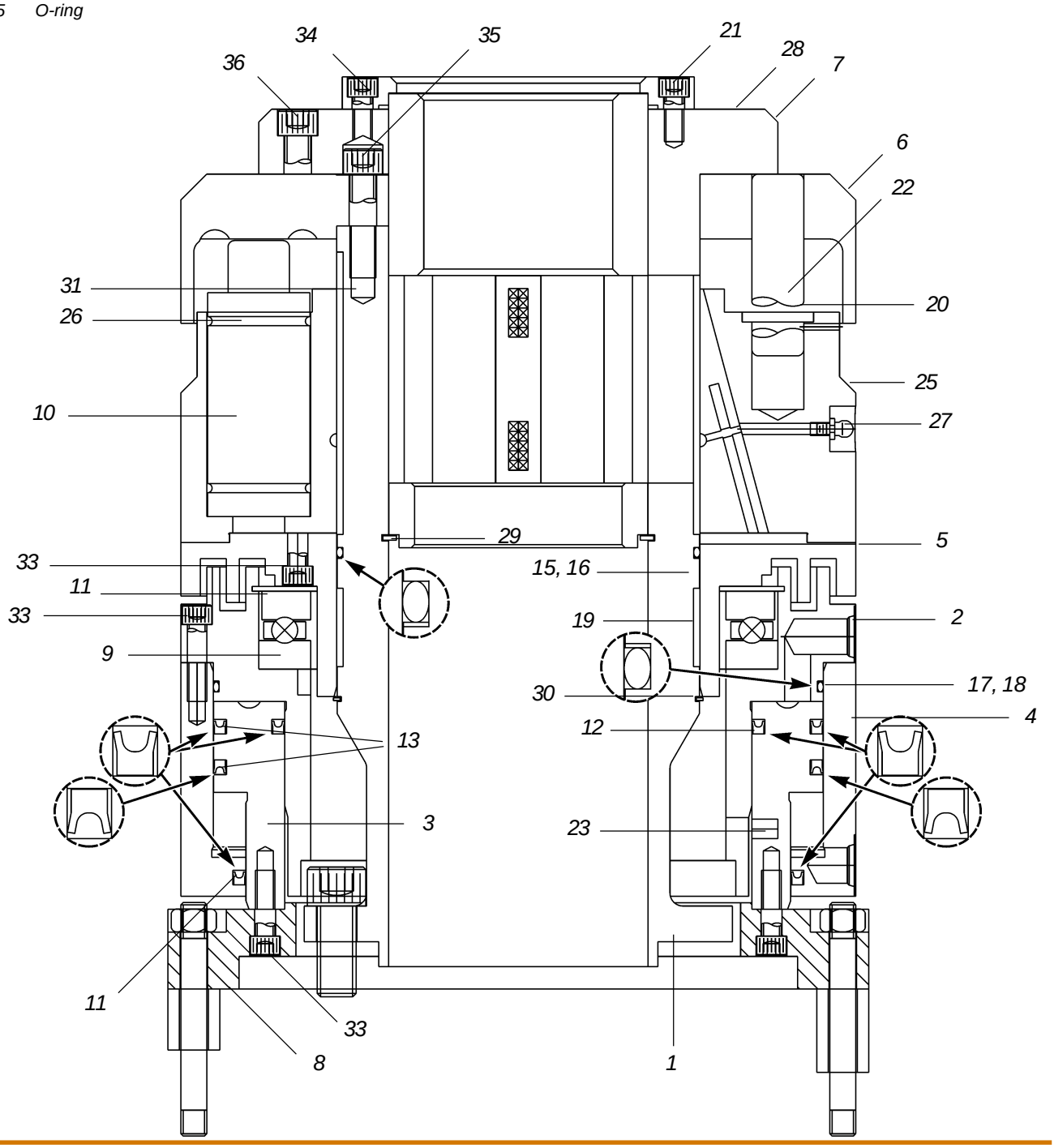
Control Panel



(**NOTE:** Actual equipment may not be exactly as shown)

PQ Nitro Gas Chuck

1 Chuck Spindle
2 Inner Cylinder
3 Chuck Piston
4 Outer Chuck Cylinder
5 Labyrinth Seal
6 Spring Retainer
7 Jaw Retainer
8 Mounting Adapter
9 Ball Bearing
10 Nitrogen Gas Spring
11 Internal Retaining Ring
12 Inner Cup Seal
13 Outer Cup Seal
14 Piston Cup Seal
15 O-ring
16 Backup Ring
17 O-ring
18 Backup Ring
19 Lower Spindle Wear Ring
20 Oil Guide Pin Seal
21 Retainer Guide Bushing
22 Dowel Pin, 1 Dia X 3-1/2 Lg
23 Dowel Pin, 3/8 Dia X 1 Lg
24 N/A
25 Bowl
26 O-ring
27 Grease Nipple
28 Set Screw, 1/2-13 UNC X 1-1/4
29 Internal Retaining Ring
30 External Retaining Ring
31 Wear Sleeve, Upper
32 N/A
33 Cap Screw, 3/8-16 UNC X 1-1/4 Lg
34 Cap Screw, 3/8-16 UNC X 3/4 Lg
35 Cap Screw, 1/2-20 UNF X 2 Lg
36 Cap Screw, 1/2-13 UNC X 1-1/2 Lg
37 Seal Kit
38 Support Plate
39 Grease



PQ Nitro Gas Chuck Assembly Procedures

Refer to Planograph on previous page.

1. Install the three dowels (item # 23) into the piston (item #3).

NOTE:

The orientation of the seals should be as shown in the planograph.

2. Install the two urethane cup seals (item #13) on the piston (item #3) outside diameter grooves. Be sure to coat the seals with hydraulic oil before installation.

NOTE:

The orientation of the seal should be as shown in the planograph.

3. Lubricate the inner urethane cup seal (item #12) with hydraulic oil and install it inside groove of the piston bore (item #3).

NOTE:

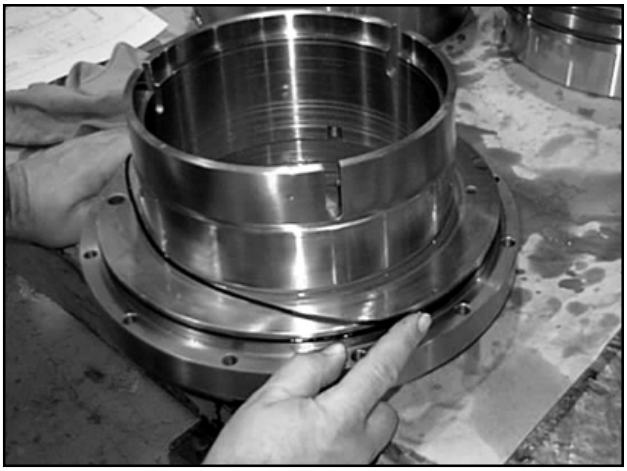
The location and proper orientation of seal should be as shown in the planograph.

4. Lubricate the urethane cup seal (item #14) and install in outer chuck cylinder (item #4).

NOTE:

The installation order should be as shown in the planograph.

5. Lubricate the O-ring (item #17) and the backup ring (item #18). Install in the O.D. of the inner cylinder (item #2).



6. Install the external retaining ring (item #30) on the PQ chuck spindle (item #1).

7. Install the lower spindle wear ring (item #19) on the PQ chuck spindle (item #1).

NOTE:

The orientation and location should be as shown in the planograph.

8. Lubricate and install the O-ring (item #15) and the back-up ring (item #16) on the PQ chuck spindle O.D.
9. Install the upper spindle wear sleeve (item #31) on the PQ chuck spindle.

NOTE:

The piston dowel must align with outer cylinder for proper assembly.

10. Align dowel with the first hole to the right hand side of the O-ring bussport of the outer cylinder (item #4).

11. Install the piston (item #3) into the outer cylinder (item #4). Gently tap piston down into place until piston is flush to the bottom of the outer cylinder.

NOTE:

Be sure to align the two oil ports as shown.

12. Install the inner cylinder (item #2) into the outer cylinder assembly (item #11) from step 5. Tap into place using a soft face mallet. Use two 3/8" UNC bolts of the proper length to align the parts.

NOTE:

There are twelve bolts required, but only install ten bolts, leaving two bolts out to allow for the attachment of a lifting device for ease and safety of further assembly.

13. Install the 3/8" UNC x 1-1/4" long socket head cap screws (item #33) using an “anti-seize”, and torque to 35 ft-lbs.

14. Bolt the PQ chuck spindle (item #1) to the shipping plate, using 3/4" UNC bolts.

    OR

    Bolt the PQ chuck spindle (item #1) to the head spindle using 3/4" UNC bolts supplied with the drive head module and torque to 280 ft-lbs.

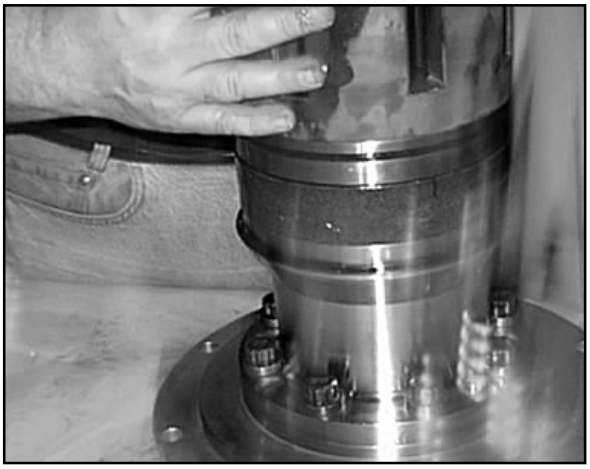
15. Install the internal retaining ring (item 29) in the PQ chuck spindle bore (item #1).

16. Grease the PQ chuck spindle O.D. with grease (item #39).

NOTE:

Boart Longyear strongly advises the use of Chevron Ultra-Duty Premium Grease (Item #39), EP #NLG12, as the only recommended grease for the PQ Nitro Chuck!

17. Bolt adapter plate (item #8) to piston (item #3).



18. Install cylinder assembly over spindle.

19. Install bearing (item #9) starting with lower thrust bearing race (larger O.D.).

20. Install bearing roller race. Pack bearing with grease (item #39) supplied.

21. Install upper thrust bearing race.

22. Install retaining ring (item #11).

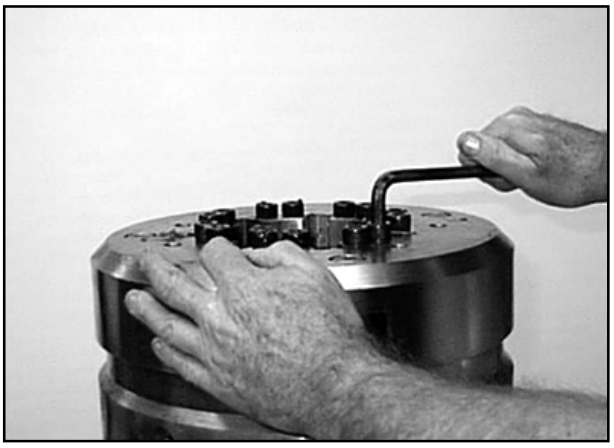
23. Install Labyrinth seal (item #5).

24. Install the 3/8" UNC x 1-1/4" long socket head cap screws (item #33) and torque to 35 ft-lbs.

25. Install bowl (item #25) onto spindle (item #1).
26. Install gas springs (item #10).

27. Install spring retainer (item #6).

28. Install 1/2"-20 UNC x 2" long socket head cap screws (item #35) and torque to 90 ft-lbs.



29. Install inner bushing (supplied separately).
30. Install jaws (supplied separately).

31. Install jaw retainer (item #7).
32. Install 1/2"-20 UNC x 1-1/2" long socket head cap screws (item #36) and torque to 80 ft-lbs.
33. Install upper bushing (supplied separately).
34. Install guide bushing retainer (item #21)

35. Install 1/2"-20 UNC x 3/4" long socket head cap screws (item #34) and torque to 35 ft-lbs.
36. Chuck assembly shown on shipping plate.

37. For chuck disassembly, follow the instructions in reverse order.

Installation of New Jaws

NOTE:
The lower spindle bushing and lower chuck bushing are NOT used for HWT/PQ sizes. To insert PQ core barrel assembly, the upper chuck bushing will have to be removed and replaced after insertion, otherwise cuttings will infiltrate the area around the mitogen gas springs.

Do not open chuck while rotating otherwise bearing life will be greatly reduced.

1. Remove the top bushing.
2. Remove jaws.
3. Remove the bottom bushing.
4. Clean jaw slots with diesel fuel or a solvent and lubricate with EP2 grease.
5. Reassemble using appropriate jaws and bushings.
6. Remove lower spindle bushing and replace with appropriate bushing.

Lubrication

1. Lubricate the chuck as per the lubrication schedule in chapter 9.

Maintenance

1. Inspect and clean jaws regularly. Replace in sets of seven only, when worn.
2. For replacement parts, refer to the chuck assembly drawing in your Parts Manual.

Nitrogen Gas Springs

CAUTION

We do not recommend field re-charge of the gas springs, please contact your Boart Longyear service representative for more information.

Nitrogen gas springs are designed to have a long service life. Inspect the gas springs periodically while changing jaws (3 month intervals).

1. Remove the spring retainer to access the gas springs for inspection and replacement.
2. Measure the free length of the exposed piston rod above the barrel. If the gas spring is still charged with nitrogen, the rod will be extended 1” (25mm). Replace any spring that does not meet this requirement.

Appendix A

See Attached

LF70 Diamond Core Drill System

DRILLING DEPTH GUIDELINES

The figures in these tables have been calculated, based on field experiences, and may be reasonably expected.

Actual drilling capacity will depend on in-hole tools and conditions, drilling techniques and equipment used.

	METRIC SYSTEM	U.S. CUSTOMARY SYSTEM
	Hole Depth (metres)	Hole Depth (feet)
DRILL ROD/CORE BARREL	Dry Hole ***(Fluid Filled)***	Dry Hole ***(Fluid Filled)***
BRQHP/BQ	915 ***(1050)***	3000 ***(3440)***
BRQLW/BQTK	1145 ***(1320)***	3750 ***(4320)***
NRQHP/NQ/NQ2"	705 ***(810)***	2310 ***(2650)***
NRQHP Upset	830 ***(960)***	2730 ***(3140)***
HRQHP/HQ	475 ***(545)***	1560 ***(1785)***
HRQHP Upset	655 ***(755)***	2145 ***(2480)***
HWT/PQ	315 ***(360)***	1025 ***(1175)***

PRIME MOVER		
Standard Unit	Deutz BF4L914, tier II, 4 cylinder, air cooled, turbocharged diesel engine.	
Displacement	4.31 L	263 cubic inch
Power (maximum)	71.7 kW	97.5 hp
Max Rated RPM (factory setting)	2450 rpm	

Optional Unit (for altitude ASL)	Cummins 4BTA 3.9, tier I, 4 cylinder, water cooled, turbocharged diesel engine.	
Displacement	3.9 L	239 cubic inch
Net Power (intermittent)	98 kW	131 hp
Max Rated RPM	2450 rpm	

HYDRAULIC SYSTEM		
Primary Pump	Axial piston, variable displacement, pressure compensated with low pressure standby.	
Max Flow	163 Lpm	43 gpm
Maximum Pressure (As used on LF 70)	24.1 MPa	3500 psi

LF70 Diamond Core Drill System

	METRIC SYSTEM	U.S. CUSTOMARY SYSTEM
Secondary Pump	Axial piston, variable displacement, pressure compensated.	
Max Flow	41.6 Lpm	11 gpm
Maximum Pressure (As used on LF 70)	13.8 MPa	2000 psi

Auxiliary Pump	Axial piston, hydrostatic drive with manual swash plate control.	
Max Flow	38 Lpm	10 gpm
Maximum Pressure (As used on LF 70)	14 MPa	2000 psi

DRILL HEAD - STANDARD HQ		
Hollow Spindle - Maximum Rod Diameter	95.2 mm	3.75 in
Rotation Motor	Rexroth hydraulic motor - variable/reversible.	
Mechanical Transmission	Funk 4 speed	
Ratios	1st 6.63:1	
	2nd 3.17:1	
	3rd 1.72:1	
	4th 1.00:1	
Final Drive	Roller chain drive.	
Ratio	2.58:1	
Hydraulic HQ Chuck	Patented Nitro-Chuck® - hydraulically opened, nitrogen gas spring closed. Axial holding capacity of 133447 N (30000 lbf)	

TORQUE AND RPM RATINGS	**Rpm**	**Nm**	**Torque lbft**
(Hydraulic motor at maximum/minimum displacement, prime mover at 2200 rpm)			
1st Gear	95 - 190	4610 - 2305	3400 - 1700
2nd Gear	200 - 400	2170 - 1085	1600 - 800
3rd Gear	370 - 730	950 - 610	700 - 450
4th Gear	630 - 1250	680 - 340	500 - 250

Drill Head Lubrication	Pressure lubrication for bearings, oil bath for roller chain.
Drill Head Lubricating Oil Filtration	10 Micron spin-on type oil filter.

LF70 Diamond Core Drill System

	METRIC SYSTEM	U.S. CUSTOMARY SYSTEM
DRILL HEAD - OPTIONAL PQ		
Hollow Spindle - Maximum Rod Diameter	122.2 mm	4.81 in
Rotation Motor	Rexroth hydraulic motor - variable/reversible.	
Mechanical Transmission	Funk 4 speed	
Ratios	1st 6.27:1	
	2nd 3.12:1	
	3rd 1.75:1	
	4th 1.00:1	
Final Drive	Straight cut gears.	
Ratio	2:1	
Head Opener	Pivoting style: manual operation	
Hydraulic PQ Chuck	Patented Nitro-Chuck® - hydraulically opened, nitrogen gas spring closed. Axial holding capacity of 222400 N (50000 lbf)	

TORQUE AND RPM RATINGS	Rpm	Nm	Torque lbft
(Hydraulic motor at maximum/minimum displacement, prime mover at 2200 rpm)			
1st Gear	122 - 199	5322 - 3254	3925 - 2400
2nd Gear	246 - 400	2648 - 1620	1953 - 1195
3rd Gear	439 - 714	1486 - 908	1096 - 670
4th Gear	769 - 1250	849 - 519	626 - 383

Drill Head Lubrication	Pressure lubrication for bearings, oil bath for gears.
Drill Head Lubricating Oil Filtration	10 Micron spin-on type oil filter.

DRILL MAST					
Lower Section	**Feed Stroke**	1830	mm	72	in
	Length	3213	mm	126.5	in
Middle Section					
	Length	3284	mm	129.3	in
Upper Section					
	Length	2705	mm	106.5	in

LF70 Diamond Core Drill System

		METRIC SYSTEM		U.S. CUSTOMARY SYSTEM	
DRAW WORKS					
Main Line Hoist (Braden)					
Hook Load (single part line)					
	Bare Drum	5450	kg	12000	lbf
	Full Drum	3720	kg	8200	lbf
Hoisting Speed (single part line)					
	Bare Drum	59	m/min	193	ft/min
	Full Drum	80	m/min	261	ft/min
Cable Capacity (maximum)		67	m of 14.3 mm cable	220	ft of 0.56 in cable

NOTE: Do not use multiple part lines with the 12000 lb hoist, use single part line ONLY.

Wireline Hoist					
Line Pull	**Bare Drum**	990	kg	2190	lbf
	Full Drum	277	kg	502	lbf
Line Speed	**Bare Drum**	100	m/min.	337	ft/min.
	Full Drum	443	m/min.	1470	ft/min.
Cable Capacity (swaged)		1898	m of 4.8 mm cable	6200	ft of 0.12 in cable

FEED CYLINDER					
Pull Capacity	**@ 2000 psi**	6414	kg	14137	lbf
Thrust Capacity	**@ 2000 psi**	4231	kg	9326	lbf

LF70 Diamond Core Drill System

DIMENSIONS AND WEIGHTS *

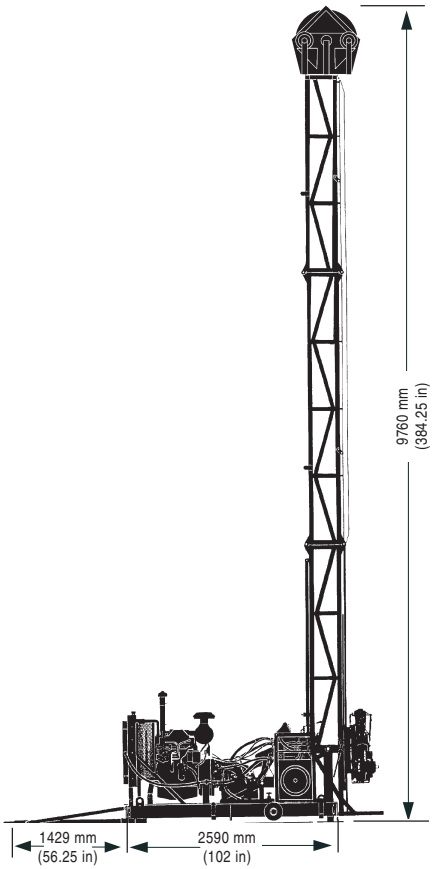
Side view of drill with mast in vertical position

Dimensions: Deduct 3235 mm (127.4 in) if Middle Mast section is removed

NOTE: Base dimensions are with mechanical stabilizer legs at the uppermost position. Overall height can be increased by 24.7 cm (9.75 in) by adjusting legs downwards.

Wet Weight : 3220 kg (6500 lb)

Consists of: Deutz BF4L 914 Power Unit Grp Tier II
Hydraulic Module
Draw Works Grp c/w Cable
Lower Mast Assembly
Middle and Upper Mast Assembly
Rotational Unit Grp c/w Nitro Chuck
Base Frame Bare
Fuel Tank (Wet) Cap 15 USG
Battery
Stabilizer Legs (x 4)
Operator Platform

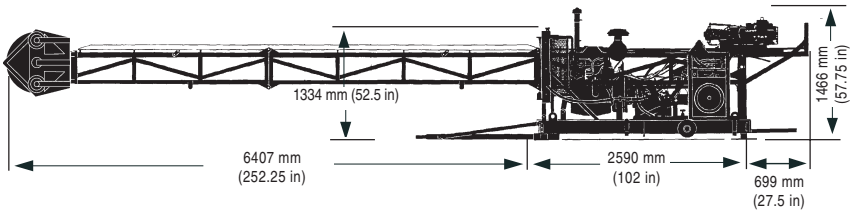


Side view of drill with mast in horizontal position

Dimensions: Deduct 3235 mm (127.4 in) from overhang if Middle Mast section is removed

Wet Weight: 3220 kg (6500 lb)

NOTE: Base dimensions are with mechanical stabilizer legs at the uppermost position. Overall height can be increased by 24.7 cm (9.75 in) by adjusting legs downwards.



* Dimension and weights are nominal and Should be checked before crating or lifting. Conversion factors have been used to convert from Imperial to Metric measures.

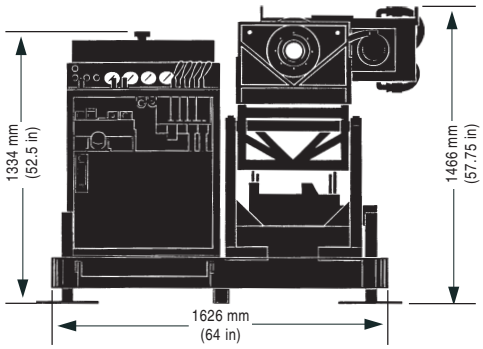
LF70 Diamond Core Drill System

DIMENSIONS AND WEIGHTS *

Rear End View of Drill (includes all mast sections)

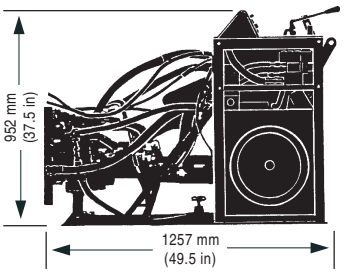
Wet Weight: 2948 kg (6500 lb)

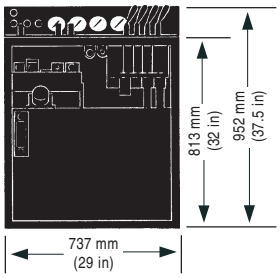
NOTE: Base dimensions are with mechanical stabilizer legs at the uppermost position. Overall height can be increased by 24.7 cm (9.75 in) by adjusting legs downwards.



Hydraulic Module

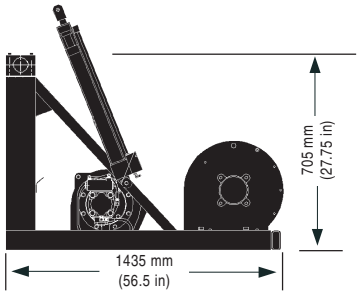
Wet Weight: 417 kg (920 lb)





Draw Works Module (KPL12)

Weight: 450 kg (992 lb) without cable



Cable Weights

Main Line Hoist Cable:	15.9 mm x 22.9 m (0.63 in x 75 ft), single part line - 26 kg (58 lb)
Wireline Hoist Cable:	4.8 mm x 1280 m (0.12 in x 4200 ft) - 118 kg (260 lb)

(Lengths above do not represent the max. rated drum capacity, they are typical values only.)

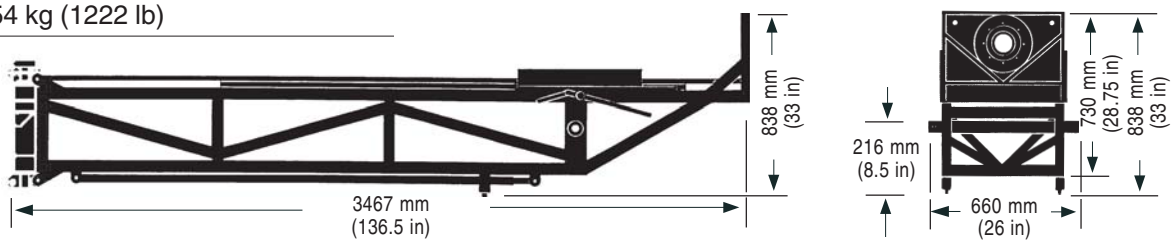
* Dimension and weights are nominal and should be checked before crating or lifting. Conversion factors have been used to convert from Imperial to Metric measures.

LF70 Diamond Core Drill System

DIMENSIONS AND WEIGHTS *

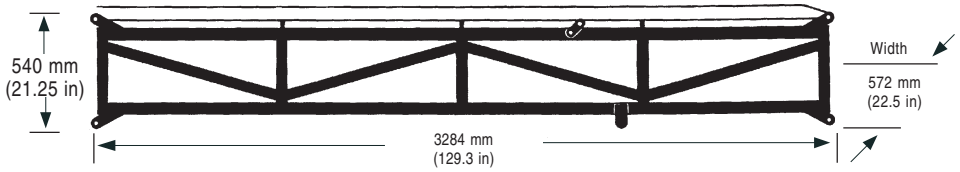
Lower Mast Section

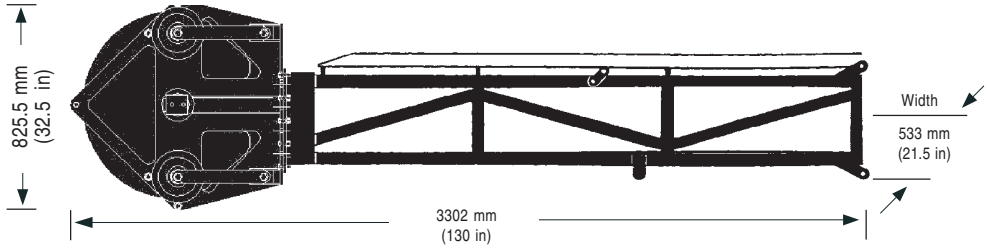
Weight: 554 kg (1222 lb)



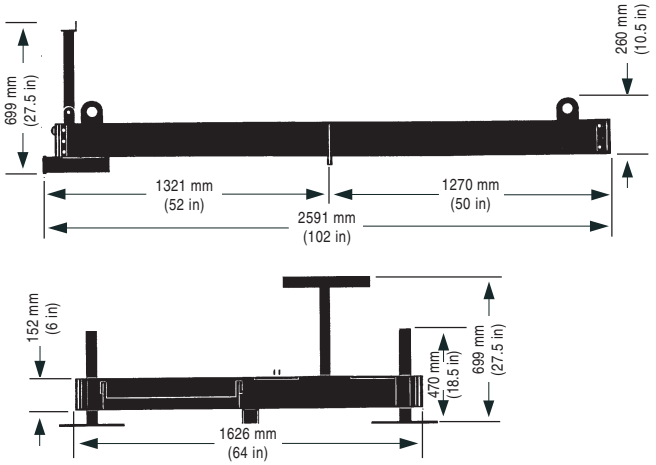
Middle and Upper Mast Sections

Combined Weight: 363 kg (800 lb)





Drill Base (Bare)	286 kg	(630 lb)
Wheel and Stub Axle (each)	51 kg	(112 lb)
Towing Hitch	25 kg	(55 lb)
Fuel Tank (wet)	57 kg	(125 lb)
Battery Box (inlcuding battery)	61 kg	(134 lb)
Mud Tank Outriggers (each)	12 kg	(26 lb)
Stabilizer Legs (each)	11 kg	(25 lb)
Operator Platform	12 kg	(26 lb)



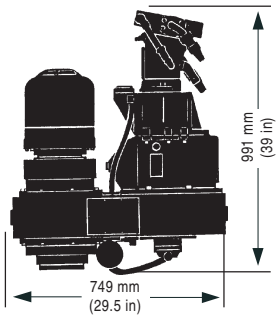
* Dimension and weights are nominal and should be checked before crating or lifting. Conversion factors have been used to convert from Imperial to Metric measures.

LF70 Diamond Core Drill System

DIMENSIONS AND WEIGHTS *

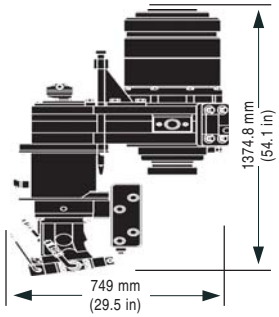
HQ Drill Head (c/w Nitro Chuck®)

Dry Weight: 376 kg (860 lb)



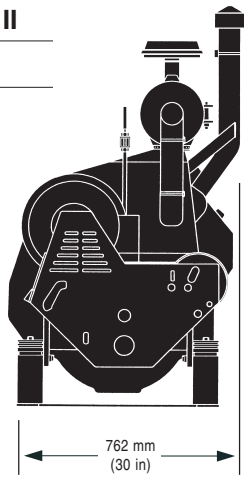
PQ Drill Head (c/w Nitro Chuck®)

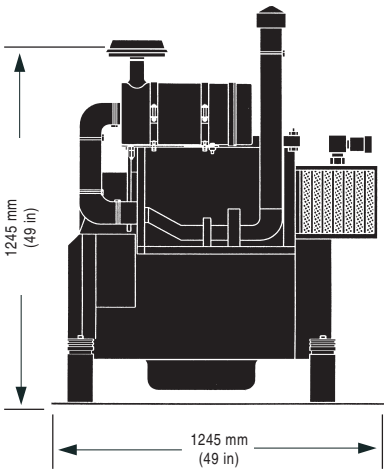
Dry Weight: 580 kg (1279 lb)



Diesel Engine Module (Deutz BF4L914) Tier II

Dry Weight: 496 kg (1094 lb)





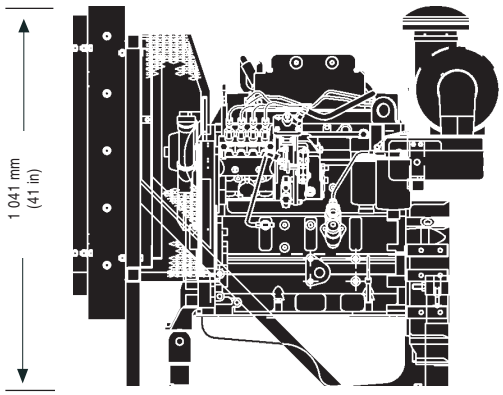
* Dimension and weights are nominal and should be checked before crating or lifting. Conversion factors have been used to convert from Imperial to Metric measures.

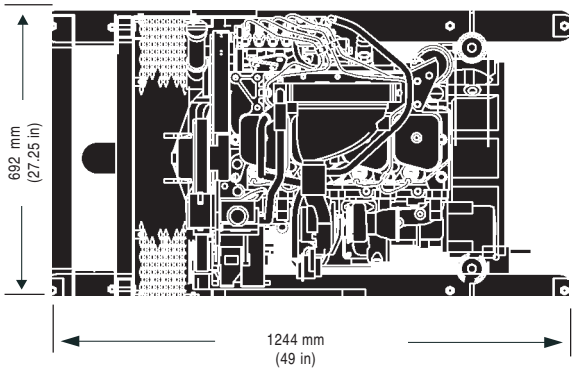
LF70 Diamond Core Drill System

DIMENSIONS AND WEIGHTS *

Cummins 4BTA 3.9 Tier I

Wet Weight: 510 kg (1124 lb)

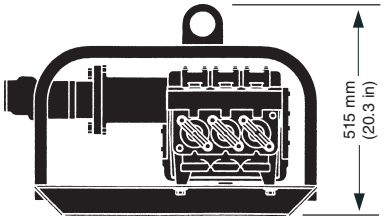


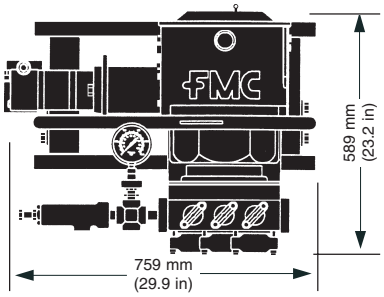


Fluid Circulation Pump Group (W09)

Wet Weight: 145 kg (320 lb)

The max. output of the standard 2-speed motor for the L09 is as follows:
High vol./low pres. - 20 gpm @ 300 psi
Low vol./high pres. - 10 gpm @ 800 psi





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LF70 Diamond Core Drill System

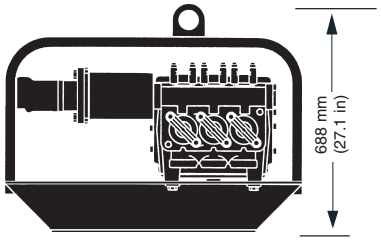
DIMENSIONS AND WEIGHTS *

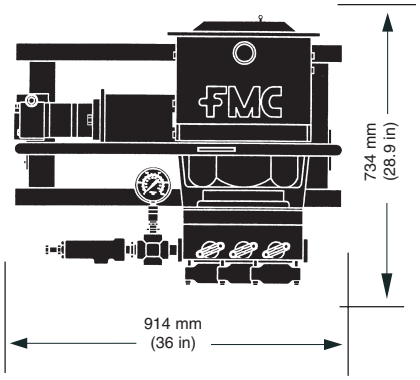
Fluid Circulation Pump Group (W11)

Wet Weight: 254 kg (560 lb)

The max. output of the standard 2-speed motor for the W11 is as follows:
High vol./low pres. 35 gpm @ 300 psi 6.2 hp
Low vol./high pres. 17 gpm @ 800 psi 7.9 hp

If a higher output pressure system is required an optional 2-speed motor can be supplied with the following max. output:
High vol./low pres. 23 gpm @ 950 psi 12.7 hp
Low vol./high pres. 11 gpm @ 1000 psi 6.4 hp

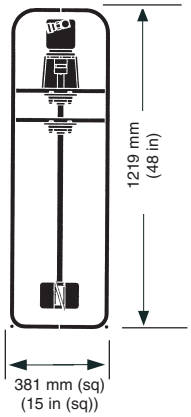




Mud Mixer Assembly

Wet Weight: 31 kg (68 lb)

NOTE: Maximum speed of mud mixer shaft at full flow is 2300 rpm.



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